
**Remedial
Investigation/Feasibility Study
Work Plan
Operable Unit 2
Quanta Resources Site
Edgewater, New Jersey**

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SECTION 1

Introduction

1.1 Project Background

This revised Remedial Investigation/Feasibility Study Work Plan (RI/FS WP) has been prepared in accordance with the requirements of the Administrative Orders on Consent II-CERCLA- 2003-2013 for the Hudson River portion, described as Operable Unit No. 2 (OU2), of the Quanta Resources Corporation Superfund Site (Quanta Resources Site or "Site"), entered into by Honeywell International Inc. (Honeywell), effective November 4, 2003. This RI/FS WP describes the RI/FS activities to be conducted at the Quanta Resources Site in Edgewater, New Jersey (Figure 1-1). The OU2 RI/FS Field Sampling Plan (FSP), Quality Assurance Project Plan (QAPP), and the Health and Safety Plan (HSP) are included as Appendices A, B, and C of this Work Plan. A separate Work Plan and RI and FS reports will be submitted by Honeywell and the Edgewater Site Administrative Group (ESAG) relative to their requirements under the OU1 AOC Agreement.

This document is a revised version of the OU2 RI/FS WP submitted to the United States Environmental Protection Agency (EPA) in January 2004 and documents the responses to comments made by representatives from the EPA Region 2, Region 2 Biological Technical Assistance Group (BTAG), and the New Jersey Department of Environmental Protection (NJDEP) over the last year and a half. These comments were addressed in several response letters and technical memoranda and also discussed in meetings on May 2 and July 13, 2006, between the Honeywell team and the EPA Region II team. A complete list of comments, responses, and a notation of where associated changes can be found in the revised WP, is provided in Appendix D.

The Quanta Resources Site is listed on EPA's National Priorities List (NPL) and it has been assigned CERCLIS ID NJ000606442. The final listing on the NPL was made on September 5, 2002. The operable units divide the Site contamination in the Upland Area (OU1), and contamination in the Hudson River areas of the Site, including surface water and sediments eastward of the Hudson River bulkhead (OU2). A site plan for OU2 is depicted in Figure 1-2. The RI/FS WP includes the proposed scope of work, site plans, schedules, and methodologies for implementing the RI tasks.

1.2 Project Objectives

The objectives of the RI at the Quanta Resources Site OU2 are to:

- Characterize potential sediment and surface water impacts associated with the former industrial activities at the Quanta Resources property.
- Define the nature and extent of site related chemicals or potential chemicals of interest (PCOIs) and delineate those impacts caused by the release these chemicals to the surface water and sediments.

- Evaluate the potential for human health and ecological impacts associated with the former industrial processes at this property.
- Develop supplemental data sufficient to address data gaps within the investigations conducted to date to determine the need for and to allow a screening of appropriate remedial alternatives, and the development of a refined conceptual site model.

1.3 Organization of this Work Plan

This RI/FS WP is organized into nine sections and four appendixes. Section 1 is an introduction to the project. A general site background and description is provided in Section 2. The site description and a summary of applicable previous investigation findings for OU2 are presented in Section 3. Section 4 describes the conceptual site model and work plan rationale. RI and FS activities for OU2 are described in Sections 5 and 6, respectively. Section 7 describes the project organization. Section 8 presents the schedule for implementing the RI tasks. References are included in Section 9. Appendix A contains the Field Sampling Plan. Appendix B contains the Quality Assurance Project Plan. Appendix C contains the Health and Safety Plan. Appendix D contains a complete list of the comments made by EPA Region 2, Region 2 BTAG, and NJDEP on the January 2004 version of the RI/FS WP, responses, and a notation of where associated changes can be found in the revised WP.

1.4 Additional Information

Two AOCs were issued for the Quanta Resources Site, one for OU1 (defined in the AOC for OU2 as "the areas of the Site, including soil, debris, and ground water, westward of the Hudson River bulkhead" and referred to herein after as the "Upland Area") and one for OU2 (defined in the AOC for OU2 as the "areas of the Site, including surface water and sediments, eastward of the Hudson River bulkhead" and referred to herein after as the "River Sediments and Water"). The respondents for OU2 are identified below.

Respondents for OU2 (River Sediments and Water):

- Honeywell International Inc.¹

¹ Note: Allied Chemical became Allied Corporation in 1981, AlliedSignal in 1987, and was renamed Honeywell International Inc. in 1999.

SECTION 2

Site Background and Description - General

2.1 Site Location and Description

The Quanta Resources, Inc. Edgewater NJ property is located in Bergen County at 163 River Road, Edgewater, New Jersey (Figure 1-1). The property is bordered to the north by the former Celotex and Lustrelon Industrial Park. The former Spencer Kellogg Industrial Park is located to the south. The Hudson River borders the property on the east and the (old) River Road borders the property to the west. The new River Road is located east of its former location and bisects a portion of the property.

Currently, the Quanta Resources property is vacant (Figure 1-2). The property contains numerous exposed concrete tank and building foundations, the remains of an oil/water separator, a wood bulkhead at the river's edge and remains of wooden docks. New River Road cuts across the western side of the property. Remnant coal tar pitch is present on the ground surface at various areas. Pockets of oily sheen occur sporadically in the mud flats of the Hudson River adjacent to the Quanta property and southern former Celotex properties. An absorbent boom is maintained to control the sheen. The former Celotex property is directly north of the Quanta property and is separated by a chain-link fence.

North of the former Celotex property is the Lustrelon property. The former Celotex and Lustrelon properties are undergoing redevelopment, where several feet of additional fill has been imported and graded bringing these properties several feet above the grade of the Quanta property. Commercial and residential structures have been erected on the Lustrelon property and northern portion of the former Celotex property. The southern portion of the former Celotex property remains at rough grade, and a new entrance has been constructed in this location near River Road. The Spencer Kellogg property, located immediately south of the property, has been redeveloped and presently includes the Interchange Bank, various offices, a newly reconstructed dock containing parking and offices, and a day-care center for the tenants. South of the Spencer Kellogg property is the Lever Brothers property, which is occupied by Unilever Research.

The Site will include the property at 163 River Road and other neighboring properties where contamination from the property may have migrated. Contamination shall be considered to mean the presence of chemicals related to former coal tar or waste oil industrial operations on the property, or allegedly emanating from the property. No information has been discovered regarding the source of the original fill materials used to reclaim the marshlands at the site for development.

2.2 Site History

From approximately 1876 to 1967 the Site was used to manufacture coal tar, paving, and roofing materials. Sanborn fire insurance maps from 1900 to 1944 identify the property as the "Barrett Company's Shadyside Plant, Manufacturers of Tar Products." Allied Chemical

Corporation Asphalt Division (now Honeywell) took over operations of the coal tar distillation plant in the early 1930s. The tar-processing plant was on the Quanta Resources property and the southern portion of the Edgewater Enterprises property. The plant operated until 1974, when the property was sold to the estate of James Frola and Albert Von Dohn. In 1977 the property was leased to E.R.P. Corporation for the storage and recycling of oil. The lease was assigned to Edgewater Terminals, Inc., and then transferred to Quanta Resources Corporation in July 1980. The property contained 61 aboveground storage tanks, at least 10 USTs, septic tanks, and underground piping. The tanks' total storage capacity was over 9 million gallons.

The NJDEP ceased facility operations at the Site in 1981 after it was discovered that large quantities of oil were present in storage tanks at the facility, including some with concentrations of PCBs. On October 6, 1981, Quanta Resources Corporation filed for bankruptcy, after which the property was no longer in use. Periodic flooding of the Hudson River, equipment failures, freezing and thawing of pipes and tanks, rusted valves and seams, and the lack of containment structures, and the migration of NAPL resulted in releases. NJDEP requested that EPA address Site contamination pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Several removal actions were conducted by Honeywell (formerly named AlliedSignal) at the Site from 1984 to 1988 under EPA oversight. Approximately 1.35 million gallons of oil were removed for offsite treatment. Over 1.5 million gallons of coal tar and petroleum/oily wastes were removed from storage tanks and recycled. In addition to storage tanks, some shallow soil and underground piping was removed. The removal actions were assessed by EPA in 1992 through the collection and analysis of soil, sediment, and groundwater samples from the Site. Additional investigations conducted prior to and subsequent to the removal actions are described in Section 1.4.3 of the Draft Preliminary Site Characterization Report (PSCR) (CH2M HILL, 2006).

In 1992, EPA conducted an assessment of the previous removal actions, which included the collection of soil, ground water, and sediment samples. Analytical results from these sampling activities indicated that CERCLA hazardous substances were present on the property.

From 1992 to present, the EPA Removal Program has conducted several sampling events that included the collection of surface and subsurface soil samples, and surface water and sediment samples from the Hudson River in areas where a sheen was observed adjacent to the Quanta property. Analytical data from these sampling events indicated the presence of elevated levels of polynuclear aromatic hydrocarbons (PAHs) and metals.

In 1997, a hydrocarbon sheen became intermittently observable at the waterfront. The EPA issued an Order requiring Honeywell to build a collection trench to stop oils from seeping into the Hudson River. Prior to submittal of the final design of the trench, it became apparent that the seeps may also be emanating from the adjoining properties. EPA decided to stop the proposed construction and do an Engineering Evaluation/Cost Analysis (EE/CA) to identify the entire problem and develop an overall solution. In 1998, Honeywell entered into an Administrative Order on Consent to perform the EE/CA. Also, under the Order with EPA (index number II-CERCLA-98-0012, dated 30 September 1998), Honeywell conducted a RSI at the Site. This investigation was conducted in 1998 and 1999 and

included the collection of surface and subsurface soil samples collected from Quanta property as well as from properties in the vicinity of the Quanta property, ground water samples collected from monitoring wells, and sediment samples collected from the Hudson River. Based on the results of activities conducted during the RSI, heavy end coal tar product was estimated to extend from the uplands to approximately 750 feet into the Hudson River.

The EE/CA report was submitted in November 1999 (which was revised/finalized in 2001 (GeoSyntec, 2001)). It recommended constructing two parallel trenches to collect heavy and light oil fractions. The EPA rejected the EE/CA in a letter dated February 16, 2000, as EPA did not believe that the trench (as designed) would be effective in controlling the discharge and recommended that the FS consider other alternatives or technologies that are more effective. Instead, the Agency recommended a sheet pile barrier in addition to the trench system. Included in that same letter was a request for Honeywell to do an "ecological evaluation" in the tidal mud flats of the Hudson River. In a meeting with EPA, it was agreed that a trench system is an adequate first step, recommending installation of the trench and then performing the ecological assessment. However, over the last year, EPA/Honeywell negotiated to conduct an RI/FS to compile additional data to address data gaps within the investigations conducted to date.

On September 9, 2002, EPA placed the Site on the National Priorities List. EPA and Honeywell entered into Administrative Orders on Consent II-CERCLA- 2003-2013 for the Hudson River portion, described as Operable Unit No. 2, of the Quanta Resources Corporation Superfund Site, entered into by Honeywell, effective November 4, 2003. In 2004, Honeywell and EPA agreed that an RI/FS for OU2 would be conducted to fill data gaps in previous investigations and provide a basis for a complete evaluation of alternatives.

2.2.1 Adjacent Property History: Edgewater Enterprises

The Edgewater Enterprises property (former Celotex Industrial Park) is just north of the Quanta Resources property (Figure 1-2). This Edgewater Enterprises property has been the site of a chemical plant, gypsum company, vacuum truck company, and metal reclaiming/refinishing plant. The chemical plant, General Chemical Company, operated on the southern portion of the property from at least 1900 to 1957. The chemical plant was used to produce acids, alums, sodium compounds, and sulfuric acid using a lead chamber process (Parsons, 2005). A gypsum company and a vacuum truck company have also occupied the Edgewater Enterprises property, and after 1974 a metal-reclaiming and -refinishing plant was operated on the southern portion of the property. Stained areas and indicators representative of a discharge to the Hudson River were identified in historical aerial photographs and may have been associated with the plant. Former operations at these areas of the Edgewater Enterprises property may have contributed to the presence of constituents similar to those detected at the Site. Between 1986 and 1989, approximately 8 ft of fill material appears to have been placed on the Edgewater Enterprises property (CH2M HILL, 2006). Additional fill material (more than 8 feet) was recently placed on the southeastern side of the Edgewater Enterprises Property adjacent to the Quanta Resources property, and this area has been developed as a parking lot. Redevelopment of this

property is ongoing and attempts are currently being made to further define the northern extent of coal tar as part of this process.

2.2.2 Adjacent Property History: Lustrelon, 115 River Road, LLC, and Lever Brothers

Detailed site history information was not available for these neighboring properties. Available information indicates that the former Lustrelon property (just north of the Edgewater Enterprises property) was the site of a lacquer spray paint and parts-cleaning operation and a raw materials warehouse. The 2000 RSI indicated that linseed oil was manufactured at the 115 River Road, LLC property (former Spencer-Kellogg facility). Sanborn maps and other historical data will be reviewed and additional information included in the RI report for OU1.

2.2.3 Adjacent Property History: Three Y, LLC property

The current building on the Three Y, LLC Block 93, Lot 1 property was reportedly used as a quality control laboratory by AlliedSignal until 1974. The building remained vacant for approximately 10 years, after which it was used for miscellaneous purposes (as an office, for storage, and as a musical rehearsal studio) and then converted to a restaurant in the early 1990s. The restaurant is now closed.

Block 93, Lot 2 historically included railroad tracks used by AlliedSignal and Faesy & Besthoff for chemical shipping and receiving. This portion of the property was owned by the New York, Susquehanna and Western Railway Corporation. The tracks were removed, reportedly in 1988, and the lot was subdivided. The northern portion of the lot was acquired by James Frola in 1988, who sold the property to Thomas Heagney in 1999. The southern portion of Lot 2 was purchased from the railway by Anthony Besthoff in 2003 (O'Brien & Gere, 2004).

2.3 Previous Investigation Summary

Previous investigations were performed on the Quanta property and the Site (as currently defined) by Parsons Engineering Science, Inc. (Parsons) in 1997 and by Roy F. Weston, Inc. (Weston) during 1992, 1995 and 1998, and finally GeoSyntec in 1999-2001. In 1999-2001, GeoSyntec compiled the analytical results from soil and sediment samples collected during these investigations with the data collected during their RSI into an assessment of the nature and extent of PCOIs. These data were incorporated into the GeoSyntec report. A limited amount of groundwater data from previous investigations were provided to GeoSyntec, but since most of the monitoring wells previously sampled were also sampled during the RSI, the previous groundwater data was not included in the RSI Report. Also, RIs were performed by Enviro-Sciences, Inc. (Enviro-Sciences) at the Celotex and Lustrelon properties during 1997.

The RI scope of work for OU2 is based on existing characterization data. The following documents contain characterization data:

- Roy F. Weston, Inc., 1992, Miscellaneous Site Investigation memoranda, sample location drawings and analytical results, 1992, 1995-1998.

- Parsons Engineering Science, Inc., May 1997 - Pre-Design Investigation at the Quanta Resources Site.
- Parsons Engineering Science, Inc., March 1998 - Data Report For Pre-Design Investigation at the Quanta Resources Site.
- Parsons, May 1999, Summary Report, Quanta Resources Site.
- GeoSyntec, June 2000 - Removal Site Investigation Report - Revision 1, Quanta Resources Site.
- EPA, August 2000, Final Report Ecological Risk Assessment, Quanta Resources Site, Edgewater, New Jersey, EPA Environmental Response Team.
- GeoSyntec, September 2001 - Engineering Evaluation / Cost Analysis (EE/CA) Report Revision 2, Quanta Resources Site.

A RSI was performed pursuant to an EPA Administrative Order on Consent index number II-CERCLA-98-0112, dated 30 September 1998. The RSI was conducted to

... (i) identify possible conduits for the transport of coal tar product from sources areas to the Hudson River; (ii) delineate source areas which continue to impact soil, river sediment, and groundwater; (iii) characterize the nature and extent of soil, river sediment, and groundwater contamination; and (iv) provide data on the geotechnical properties of the [Site] soils in support of evaluation of engineered site remedies.

The scope of work included test trenching and a geophysical survey, soil boring advancement, cone penetrometer testing, sediment sampling, monitoring well installation and groundwater sampling, and a geotechnical engineering evaluation. Field activities were conducted in 1998 and 1999, including completion of 17 test trenches, 14 soil borings, 10 monitoring wells, and 10 cone penetrometer test/Rapid Optical Screening Tool (ROST™) sediment locations. Nine surface soil samples, 26 sediment cores, and 10 deeper Vibracore sediment samples were collected. Ten penetrometer test/ROST™ locations were completed in sediment. Twenty existing groundwater monitoring wells and eight of the 10 new monitoring wells were sampled during the RSI. Surveying and tidal fluctuation monitoring was also conducted.

Currently the former Celotex and Lustrelon properties are being managed under NJDEP jurisdiction. Some clean-up operations are still in progress at these properties, but these operations are being managed by other responsible entities for those properties. The data provided to GeoSyntec for the former Celotex and Lustrelon properties are discussed in the RSI report but may not represent the current conditions at these areas due to remediation actions directed at hot spot areas on these properties.

Subsequent to completion of the RSI, an EE/CA Report was prepared by GeoSyntec in September 2001. The EE/CA was prepared pursuant to EPA Administrative Order on Consent. The EE/CA evaluated potential response actions to be taken to mitigate current and future releases from the Quanta property. In accordance with the SOW enforced by the AOC, the EE/CA evaluated alternatives that addressed the release of non-aqueous phase liquid (NAPL) to the Hudson River and the Upland Area contamination.

A discussion of the applicable findings of the previous investigations for OU2 is provided in Section 3 to provide framework for the proposed investigation presented in Sections 4, 5, and 6. The previous environmental sampling locations are shown on Figure 2-1.

2.4 Geologic and Hydrologic Setting

The Site is located in the Piedmont Physiographic province of New Jersey (Drake et al., 1996). This region, also called the Triassic Lowlands, is marked by low, north-south-trending hills. Elevations in this province range from near sea level at the Site to 771 feet farther west. The Triassic lowlands are underlain by rocks of the late Triassic Newark Group, which is made up of both sedimentary and igneous rocks. The bedrock at the Site is composed of a fluvial/alluvial deposit of arkose (feldspathic arenite), mudstone, and conglomerate known as the Stockton Formation, which is part of the Newark Group and is a narrow area of rock between the Palisades Diabase to the west and Hudson River Deposits to the east (USDA, 1994). The Stockton Formation is overlain by 30 to 60 ft of unconsolidated deposits consisting of 20 to 40 ft of estuarine and salt marsh deposits overlain by 10 to 20 ft of non-native fill.

The native estuarine and salt marsh deposits overlying bedrock at the Site consist of 5 to 10 ft of fine to medium well-sorted sand followed by 10 to 20 ft of soft silt and clay that contains traces of roots and shell fragments; this is overlain by 5 to 10 ft of medium to coarse, poorly sorted sand. There is a discontinuous peat layer observed in the western portion of the Site east of River Road. The marsh deposits pinch out to the west near River Road. The non-native fill consists of a mixture of gravel, sand, and silt with cinder/slag material, brick, wood, and concrete fragments overlying the native soils (CH2M HILL, 2006). The U.S. Department of Agriculture (USDA) classifies the soils at the Site as Urban Lands (USDA, 1994). A wooden bulkhead separates the upland OU1 portion of the Site from the Hudson River (OU2) portion of the Site.

A tidally influenced mud flat/marsh associated with the Hudson River (OU2) borders OU1 to the east. These river sediments consist of silt to clayey silt approximately 45 ft thick immediately east of the bulkhead; these sediments thicken eastward to approximately 250 ft thick beneath the main channel of the river. These mud flats are exposed to approximately 500 ft from shore during low tide and are flooded under approximately 6.5 ft of river water during high tide.

Three distinct hydrostratigraphic units exist at the Site above the bedrock surface. The shallowest unit consists of an unconfined, surficial water-bearing zone extending from the water table (about 9 ft below ground surface [bgs]) to approximately 15 to 20 ft bgs (unconfined shallow groundwater). This unit is underlain by a silty clay aquitard approximately 10 to 20 ft thick. Last, a confined water-bearing "deep sand" unit exists between the aquitard (confining unit) and the bedrock surface. This deep sand unit is 5 to 10 ft thick, and extends to the bedrock surface, which is located at 30 to 60 ft bgs. In some places at OU1, the potentiometric surface of this water-bearing zone is approximately 1 to 3 ft higher than the unconfined water table unit (e.g., upward vertical hydraulic gradients).

SECTION 3

Site Description – OU2

3.1 NAPL Delineation in Sediment

NAPL was previously delineated in the sediment at OU2 using cone penetrometer testing (CPT) with Rapid Optical Screening Tool™ data. The results of the ROST™ survey indicates that interbedded clay silt and PAH contamination extends to a distance of approximately 700 ft east of the bulkhead. The positive ROST™ results may indicate the presence of NAPL, but these results may also be detecting other PAH contamination because the ROST™ screening does not specifically target coal tar.

NAPL is present in the river sediments and it consists of thin lenses of oil-like product interbedded with silt. Near the shore (based on Vibracore and hand auger data) the lenses of product are more prevalent and increase in thickness and abundance to a depth of 20 ft. About 180 feet from the shore (ROST™ locations R7 and R10), the product lenses appear to extend to between 27 and 31 feet below the top of the sediment. The product lenses increase in depth as one moves away from the shoreline to the east (CPT-R1 indicated elevated PAHs between 30 and 50 ft which may or may not be product). The surface sediments (~0-5 ft) in most areas contain little to no product. The eastern extent of the product in the river sediments is defined by three ROST™ locations (CPT-R2, CPT-R5 and CPTR6) – it is argued in the RSI (GeoSyntec, 2000) that the heavy-end product in these logs (low fluorescence response) may be related to the Quanta Resources Site, but that it is more likely typical of "background" hydrocarbon contamination in river sediments. CPT/ROST™ logs R3 and R4 do not show any hydrocarbon response. This distribution is generally consistent with the conceptual model presented in the RSI (GeoSyntec, 2000), and assumes a sloping sediment bottom over which the product was distributed, which was then filled in via natural sedimentation (leaving product at greater depths farther away from the shoreline).

EPA comments note that cross sections in the RSI (GeoSyntec, 2000) show surface sediments are free of product (based on the CPT-ROST™ responses), and correctly note that this is misleading because there are oil seeps coming from the sediment near the shore at low tide. They further suggest that individual seeps may be acting in a diapiric fashion that concentrates the oil and moves it up through the sediment, resulting in sediments that are contaminated but not in a uniform fashion.

3.2 Sediment Chemistry

Sediment samples from the Hudson River were previously collected by GeoSyntec (2000) using various methods. These methods included the following: 1) Ponar sampler (9) – surface sediment samples; 2) sediment core sampler (26) – surface and shallow subsurface samples up to 7 ft; 3) hand auger boring (1) – advanced to 12 ft near bulkhead for collection of one sample; 4) Vibracore (10) – samples at 20 ft; and 5) CPT/ROST™ (10) – logs were interpreted based on response profiles. A summary of sediment chemistry on the Quanta property and on adjacent properties is provided in Tables 3-1 and 3-2. In these tables,

minimum and maximum concentrations for 0-1 ft and greater than 1 ft are compared to effects range low (ER-L) and effects range median (ER-M) values of Long et. al. (1995). Sediment chemistry results are summarized on Figure 3-1.

In addition, the EPA conducted an ERA using site-specific sediment data (EPA, 2000). These sediment samples were collected from 0 to 6 inches and 6 to 12 inches. The EPA ecological risk assessment is discussed further in Section 3.4.

3.2.1 Volatile Organic Compounds

Volatile organic compounds (VOCs) were measured in sediment samples SED-1.5C and SED-3.5C collected in 1998. In sample SED1.5C, the VOCs were composed of benzene, toluene, ethylbenzene, and xylene (BTEX) compounds at a total concentration of 28.8 mg/kg. The total VOC (xylenes and carbon disulfide) concentration in SED3.5C was 0.82 mg/Kg.

VOCs were measured in all eight sediment samples collected in 2000 by the EPA. Concentrations of naphthalene ranged from 31,000 µg/kg (Location 1 duplicate) to non-detect. p-isopropyltoluene was detected only at Location 2 (74 µg/kg). Acetone was detected in seven samples as well as QA blanks. 2-butanone ranged from 110 µg/kg (Location 4) to non-detect (EPA, 2000).

3.2.2 PAHs

PAHs were detected in all 70 samples collected in the RSI. The highest concentrations of PAHs were found in sediment (visibly stained with thin seams of coal tar) adjacent to the Quanta Resources property at depth of 2 to 12 ft below the top of sediment. PAH concentrations in this depth range decreased with increasing distance from the shoreline; however, higher concentrations were found at even greater depths (17-20 ft) farther from the shoreline (samples VC-05 and VC-06). The extent of elevated PAH concentrations in these deeper samples decreases with increasing distance from the shoreline (as evidenced by samples from CPT-8A and CPT-9A, which contain less than 3,000 mg/kg of PAHs). PAHs above 300 mg/kg were found in only two samples that were collected from areas outside the area containing coal tar product (SC-02 and SC-04 near the former Lustrelon property). In samples where PAHs were detected, the total PAH concentration was above the total PAH ER-L and ER-M values of 4.02 mg/Kg and 44.79 mg/Kg, respectively.

The EPA collected and analyzed sediment for Base, Neutral, and Acid (BNA) Extractable Compounds at the Quanta Site. Twenty-three BNA compounds were detected at the Site. Location 1 had the highest concentrations of all BNA compounds (except di-n-butylphthalate) (EPA, 2000). The highest concentration of any BNA was naphthalene detected at 110,000 µg/kg at Location 1. The concentration of BNAs decreased at samples locations collected at some distance away from the bulkhead and Location 1 (EPA, 2000).

3.2.3 PCBs

Results show that PCBs were widely distributed in the Hudson River (PCBs found in 69 of 70 samples during RSI). Total PCBs were below 2 mg/kg in most samples. The maximum total PCB concentration was 6.5 mg/kg in the 4 ft sample at SC-09. Aroclors 1242, 1248, 1254 and 1260 were the most commonly detected PCBs in sediment. All detected

concentrations were above the total PCB ER-L and ER-M values of 0.0227 mg/Kg and 0.18 mg/Kg, respectively. No PCBs were detected in any of the sediment samples analyzed by the EPA in 2000. The sediment concentrations are higher than maximum PCB concentrations detected in on site soil samples. The highest concentration for all PCBs detected in surface soil on site during the 2005 OU1 RI work was Aroclor 1260 at 1.1 mg/Kg (CH2M HILL, 2006).

3.2.4 Pesticides

The EPA collected and analyzed sediment samples for pesticides. Endosulfan II was detected at Location 1 (duplicate) at a concentration of 9.7 µg/kg and was not detected in any other samples. Endosulfan sulfate ranged from 31 µg/kg (Location 1 duplicate) to non-detect (Locations 4, 5, and 6). 4,4'-DDT concentrations ranged from 28 µg/kg (Location 1) to non-detect (Locations 2, 3, 4-sub, 5, and 6). Concentrations of gamma-chlordane ranged from 79 µg/kg (Location 1) to non-detect (Location 6). Concentrations of DDT and chlordane were reported in excess of the ER-L values in all locations where they were detected. No other pesticides were detected at the Site.

3.2.5 Inorganics

Inorganics (arsenic, chromium, and lead) were characterized by the existing site data. Arsenic was detected in all 70 RSI samples. The highest concentrations (> 300 mg/kg in both surface and subsurface) were in samples from the Hudson River sediment near the Lustrelon property (e.g., SC-01, SC-02, SC-04, and SC-05). Arsenic concentrations in ground water directly upgradient of the sediment with the highest arsenic ranged from ND to 0.27 mg/L. In addition, arsenic concentrations in upland soils were lower than those in sediment.

Chromium was detected in all sediment samples collected during the RSI. Chromium concentrations range between 40 mg/kg and 270 mg/kg in the Hudson River sediments. Chromium concentrations appeared to be evenly distributed; however, concentrations were slightly higher in subsurface sediment samples compared to surface samples. Chromium concentrations were substantially higher in sediments than in upland soils (CH2M HILL, 2006).

Lead was detected in all of the RSI sediment samples. The concentrations were generally below 400 mg/kg. The highest concentrations of lead (> 400 and 1540 mg/kg) were found in sediment samples adjacent to the Lustrelon property (SC-01, SC-02, SC-04) in an area where elevated arsenic and chromium were also found.

The EPA collected and analyzed eight sediment samples for TAL metals. All metals were detected in at least one sample, except for selenium and thallium. Metals were detected at higher concentrations at Location 1. Arsenic, copper, lead, mercury, nickel, silver, and zinc were detected in excess of the ER-L values in all sample locations. Cadmium was in excess of the ER-L value at Locations 1 and 2-sub. The concentrations of mercury were in excess of the ER-M value at all locations. The concentration of silver was in excess of the ER-M values at Locations 1, 2-sub, and 4-sub.

3.2.6 Total Organic Carbon

The range of total organic carbon (TOC) percentages was 2.16 % to 3.88 % in 15 samples collected from the upper portion (0 to 1 foot) of sediment in a large area of the river portion of the site (i.e., near shore to 800 feet from the shoreline). These data indicate that there is the potential of volatile or semivolatile organics moving in ground water to be adsorbed (or retarded) to naturally occurring organic carbon in the sediments before discharging to the Hudson River.

Sediment samples collected by the EPA were analyzed for TOC. TOC ranged from 11,000 mg/kg or 1.1% (Location 2) to 22,000 mg/kg or 2.2% (Location 1).

3.2.7 Surface Water Classification

Surface water in the Hudson River adjacent to the Quanta Resources Site is classified as SE2, according to the Surface Water Quality Standards, N.J.A.C. 7:9B [Hudson River (Englewood Cliffs) - River and saline portions of New Jersey tributaries from the confluence with the Harlem River, NY to a north-south line connecting Constable Hook (Bayonne) to St. George (Staten Island, NY). "SE2" mean saline estuarine waters whose designated uses are listed in N.J.A.C. 7:9B- 1.12(e). All SE2 waters the designated uses are:

- Maintenance, migration, and propagation of the natural and established biota
- Migration of diadromous fish
- Maintenance of wildlife
- Secondary contact recreation
- Any other reasonable uses

3.3 Surface Water Chemistry

No surface water chemistry data was previously collected based on the existing environmental reports reviewed during the preparation of this work plan.

3.4 Summary of Ecological Risk Assessment

EPA conducted an ERA using site-specific data collected in May 2000 (EPA, 2000). The ERA was prepared to evaluate the potential threats to ecological receptors from exposure to contaminants identified within the sediments of the tidal flat adjacent to the Quanta Resources Site.

The four assessment endpoints selected for evaluation were as follows:

1. Viable tidal flat community structure and tidal flat community functioning
2. Tidal flat nursery and refuge functioning
3. Viable piscivorous bird community
4. Viable omnivorous mammal community

Evaluations of risk to the resident piscivorous bird community and omnivorous mammal community were not completed because prey items were not available for collection and tissue residue analysis of contaminants. Consequently, food chain modeling for these

higher order receptors was not completed. Measurement endpoints were selected to quantify the potential effects of contaminants within the tidal flat to identified receptors. The tidal flat community structure and function and tidal flat nursery/refuge function were evaluated via a benthic community survey and solid phase toxicity tests at six locations. In addition, surface sediment samples (0 to 6 inches) were also collected at all six locations. Subsurface samples (6 to 12 inches) were also collected at two of the locations, for a total of eight sediment samples. All sediment samples were analyzed for BNA extractables, semi-volatile organic compounds (SVOCs), VOCs, target analyte list (TAL) metals, pesticides/PCBs, oil characterization, TOC, and grain size.

Benthic macroinvertebrate samples were collected at all the locations via acetate core sleeves 7.6 cm wide and 15 cm long, (six replicates per site). After being identified to the lowest practical taxonomic level, the benthic macroinvertebrate community structure was evaluated by comparing a number of community measures between locations. Because of the small number of organisms collected from each location, comparisons were not made between replicates at each location.

The toxicity tests conducted on sediment collected from each site (including the two subsurface sediment samples) were a 14-day (modified 10-day acute) toxicity test using the amphipod *Leptocheirus plumulosus*, and a modified 7-day solid phase, flow through toxicity test with the silverside minnow, *Menidia beryllina*. Test endpoints included survival, growth, and reburial for the 14-day *L. plumulosus* toxicity tests and survival and growth for the 7-day *M. beryllina* toxicity tests.

The results of the analytical testing of sediment from the ERA (EPA, 2000) are summarized in Table 3-3 and discussed below:

- BNA constituents, VOCs, various pesticides/PCBs, metals, and total petroleum hydrocarbons (TPH) were detected in sediments collected from the tidal flat. Generally, concentrations of the detected constituents decreased as distance increased from Location 1 and the bulkhead.
- The concentrations of detected BNAs, for which guidelines exist, were in excess of the respective ER-L value at all locations. The concentrations of most BNAs for which guidelines exist were in excess of the respective ER-M values at sample Locations 1, 2, 2-sub, 3, and 4.
- No sediment guidelines exist for VOCs detected in the sediment.
- The concentrations of DDT and chlordane were in excess of the ER-L values at all sample locations where these pesticides were detected. The concentrations were less than the ER-M values at all locations.
- The concentrations of arsenic, copper, lead, mercury, nickel, silver, and zinc were in excess of the ER-L values at all sample locations. The concentrations of cadmium were in excess of the ER-L value at Locations 1 and 2-sub. The concentrations of mercury were in excess of the ER-M value at all sample locations. The concentrations of silver were in excess of the ER-M value at Locations 1, 2-sub, and 4-sub.

The results of the benthic macroinvertebrate survey from the ERA (EPA, 2000) are summarized in Table 3-4 and discussed below:

- Overall, oligochaetes numerically dominated all samples, accounting for 82.4 to 94.4 percent of organisms collected, while the largest number of taxa collected consisted of polychaetous annelids, with eight total polychaete species.
- The lowest diversity, as measured by the Shannon-Weiner diversity index, was encountered at Locations 1, 2, 3 and 4, with scores ranging from 0.304 at Location 4 to 0.419 at Location 1. Locations 5 and 6 were farthest from the bulkhead and exhibited the highest diversity, with scores of 0.827 and 0.812 respectively.
- Pielou's species evenness index at the site was the lowest at Locations 1, 2, 3 and 4, with scores ranging from 0.030 at Location 4 to 0.060 at Location 1. Locations 5 and 6 received the highest scores, 0.069 and 0.081, respectively.
- High densities of benthic organisms were not evident at any of the six locations. The lowest organism abundances were encountered at Locations 1 and 6 (167 and 153 individuals respectively); highest organism abundances were encountered at Locations 2 and 4 (1253 and 1385 individuals respectively).

The results of the sediment toxicity test from the ERA (EPA, 2000) report are summarized in Table 3-5 and discussed below:

- Sediment from six sample locations (Locations 2, 2-Sub, 4, 4-Sub, 5, and 6) exhibited no significant adverse effect on *L. plumulosus* survival.
- Significant reduction in *L. plumulosus* survival was encountered in sediments from Location 1 and Location 3, when compared to the laboratory control.
- Sediment collected from Location 1 was diluted with clean sediment to concentrations of 1, 10, 50, and 100 percent site sediment. Based on the results of this serial dilution, an approximate lethal concentration (LC₅₀) at which half the exposed *L. plumulosus* could be expected to die was calculated to be approximately 17 percent.
- *L. plumulosus* growth was significantly less at all sample locations when compared to the laboratory control. Mean growth based on dry weights ranged from 0.4 mg at Location 1 (100 percent site sediment) to 0.724 mg at Location 2 (surface sediment), compared to 0.9 mg in laboratory controls.
- Reburial was significantly lower in organisms exposed to Location 2-Sub and Location 3 sediment when compared to laboratory controls. Percent reburial for Location 1 sediment concentrations of 100 and 50 percent were not included because of high mortality.
- Sediment from seven sample locations (Locations 2, 2-Sub, 3, 4, 4-Sub, 5, and 6) exhibited no adverse effect on *M. beryllina* survival.
- *M. beryllina* exposed to Location 1 exhibited 100 percent mortality by test termination.

- *M. beryllina* growth was significantly different from laboratory controls at Location 4. All other locations (Location 1 was evaluated because of to 100 percent mortality) did not exhibit significantly different growth when compared to laboratory controls.

Based on the results presented in the ERA, EPA concluded that the contaminants detected in the sediment at the Quanta Resources Site pose risks to the structure of the tidal flat communities using the site, specifically risks to survival, growth, and reproduction. Data supporting the conclusion include: the lethal and sub-lethal responses encountered in the sediment toxicity tests by both *L. plumulosus* and *M. beryllina*, the presence of a low diverse benthic macroinvertebrate population (primarily consisting of deposit feeders), and elevated concentrations of metals (arsenic, chromium, copper, lead, mercury, nickel, silver, and zinc), BNAs (naphthalene, 2-methylnaphthalene, acenaphthylene, acenaphthene, fluorine, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(k)fluoranthene, benzo(a)pyrene, ideno(1,2,3-cd)pyrene, dibenzo(a,h)anthracene, benzo(g,h,i)perylene), and pesticides/PCBs (chlordane and DDT) in sediments that exceed sediment benchmarks.

Furthermore, EPA concluded that fish and shellfish using the tidal flat exclusively for its functionality as a nursery and/or refuge are at risk from site contaminants of concern.

Given the data presented in the ERA, EPA also concluded that there appears to be a current and active release of contaminants of concern along the base of the bulkhead and sample Location 1.

Based on the results and conclusions of the ERA, further evaluation will be conducted to reduce the uncertainty and to fill data gaps. The additional assessment activities described in subsequent sections of this WP will be incorporated into a Baseline Ecological Risk Assessment (BERA) as part of the ongoing RI/FS. The overall approach to the BERA is summarized in Section 5.0; however, specifics will be presented in a BERA WP. The BERA WP will be submitted to EPA 60 days after receipt of the OU2 RI field data and concurrence on reference locations is received from the EPA.

3.5 Summary of Public Health Assessment

The New Jersey Department of Health and Senior Services (NJDOHSS), the Agency for Toxic Substances and Disease Registry (ATSDR), NJDEP, and EPA visited the Site on January 19, 2001, and NJDOHSS conducted a public health assessment of the Site. For each of the potential pathways evaluated (i.e., surface soil and dust, ambient air, sediment), there is presently no *route of exposure* element to complete the human exposure pathway at the Site. According to the Assessment, this is due to the fact that the Site is currently closed to entry, portions of the Site are covered with asphalt, and no work activity is occurring at the site at the present time. During both Site visits, however, there were indications of trespassers at the Site (e.g., footprints, evidence of individuals walking their dogs). The potential for exposure to these individuals on a routine basis is unlikely and does not justify a completed exposure pathway designation. Based upon available information and observation at the Site, potential human exposure routes may include dermal contact with and/or incidental ingestion of contaminated on-site soils and river sediments. Although site-specific air data were not available for review by NJDOHSS for the Public Health

Assessment, general concerns regarding odors at the Site may suggest a localized potential air pathway, especially during any future remediation and/or construction activities which disturb on-site soils. Additionally, these activities may produce fugitive dust exposures for the nearby community. There are no data currently available that establish a completed exposure pathway to nearby human populations. Although data was limited, results of air and soil sample data from the Palisades Child Care Center do not indicate a health concern.

SECTION 4

Conceptual Site Model

where is Arsenic?

The existing conceptual model for OU2 was reviewed as part of the development of this work plan, and where appropriate, additional clarifying information was added to make the model more comprehensive with regard to all of the environmental media and current site conditions. The OU1 Upland Area model of migration of materials at the Quanta property is described in the OU1 Work Plan (Parsons, 2005).

The initial conceptual model called for development of the Site in three stages. Prior to individualized development, the area now known as the Quanta Resources Site was a broad marshland with low topographic relief sloping gradually to the riverbank of the Hudson River. Initial industrial development resulted in installation of a wooden pile bulkhead and backfill of 10 or more feet of non-native fill (marsh reclamation). In the uplands portion of the site (OU1), releases from tar stills, oil storage tanks and other vessels were sources of NAPL in subsurface soils and on the ground water table. The NAPL releases to the subsurface soils on the site are also a likely source for the dissolved plumes of VOCs, SVOCs, PAHs, and metals.

The development of the Quanta Resources Site also included dredging of the near-shore marsh sediments (OU2) for barge access to the bulkhead. Upon cessation of the Quanta Resources industrial operations (and with further pre-construction and other related development upriver and downriver) sediments accreted in the dredged area. Lenses of coal tar product became dispersed within the sediment as accretion continued and coal tar spilled into the mud flats from upland sources. These lenses appear to be buried to depths of up to 40 ft or more. There are four primary considerations for evaluation of the potential for ecologically significant transport of coal tar and creosote NAPLs in tidal sediments:

1. Is there a direct connection between the sediments and the coal tar source without transport through the open water?
2. What is the interaction between tides and the coal-tar containing sediments?
3. Has the coal tar weathered over time?
4. What is the residual concentration in the sediments accounting for grain-size, organic content, mineralogy of the sediments?

should assume non-point source.

Coal tar NAPL can be transported into the sediments through three general pathways, each of which may cause substantially different conditions for coal tar fate and transport:

- Direct flow from the source underground through soils or bedrock and directly into the sediments at depth
- Flow through the water column onto sediments that can then act as a "sponge" for their downward flow

CSM should reflect that there is probably no current transport into the sediments

Flow through bulkhead was

Flow through the water column into a sediment accreting environment where the sediment will fill over the coal tar in time

It is currently believed that the last of these three cases is typical of the coal tar NAPL that may be present in the sediments at the Quanta Resources Site. Based on this case, the following conceptual model can be developed for the NAPL migration potential in the sediments and related environmental risk.

OK

The coal tar would have flowed out at the bulkhead through subsurface piping or surface run-off during and shortly after plant operations in the open water. This would allow some interaction between the coal tar and water at that time which should have caused some weathering by dissolution and biodegradation of light-end compounds in the coal tar (e.g, benzene, naphthalene, methyl-naphthalene, etc.) which act as a solvent that allows the coal tar to be mobile.

disagree

It appears that the sediments accretion has filled in over coal tar NAPL. The coal tar NAPL would have filled in pore space within the sediment. Since the organic sediment is likely to be wetting to the NAPL, particularly the organic and PAH components of the sediment from other sources, there may be coal tar causing vertical and lateral migration until the residual concentration is reached. - This doesn't require an oil-wet medium.

OK

Concurrently, the daily tides can range up to 6 feet. This initially causes unit pore pressure gradients in the thin accreting sediments. The upward and downward pore pressure changes cause the NAPL to "emulsify" within the sediment as they are forced upward and downward by the changing tidal induced pore pressure changes (this may be one reason why NAPL has not been mapped in the 0 to 5-foot depth in the sediments). Since the specific gravity of coal tar is typically in the range of 1.05 to 1.10, any gradient larger than 10% is likely to cause upward NAPL migration.

agree

The thickening sediment column will cause the NAPL concentration in the sediment to decrease with height in the sediment column due to both increasing sediment mass and volume absorbing/adsorbing the coal tar and reducing hydraulic gradients in the deeper sediments reducing the forces pushing the NAPL upwards from its original elevation. Most of the coal tar is likely present at less than the residual concentration in the sediments which makes it unlikely to migrate under its own gradients.

OK

Small blebs can break free from the sediments from two sources. Small blebs can be transported, essentially as particle transport, through pore spaces in the sediments. The large upward hydraulic gradients occurring during falling tides can loosen the sediments and cause localized channels to temporarily open. Where coal tar is somewhat continuous in a layer, it effectively creates an impermeable horizontal barrier. The upward gradients during falling tide will find a weak point in this horizontal barrier and burst through that zone for pressure relief carrying some of the coal tar with it, often through a vertical channel that temporarily opens. These conditions give the appearance of clam holes squirting NAPL out. NAPL pools that are 10 feet or more below the sediment surface can generate these conditions.

The emulsification process inherent in these tidal sediments also can cause weathering of the coal tar rendering the NAPL largely immobile over time. The light end concentrations in emulsified tidal sediment coal tars are usually much lower than the original parent coal

tar. Over time, these NAPLs will end up as heavy PAHs that are adsorbed to the soil grains. The lighter PAHs are amenable to biodegradation and disappear from the system. The ratio of VOCs and two/three ring PAH mass to the total coal tar mass is a good indicator of the weathering and mobility state of the coal tar.

The suspected high sedimentation rate that occurred during and after operations and dredging means that a relatively large amount of sediment accumulated at the Quanta Resources Site from upgradient sources. Therefore, consideration for potential upgradient (background) sources of constituents found in the sediment needs to be incorporated into the overall approach for evaluating the impacts from operations at the Quanta Resources Site.

You should add the process of methanogenesis to this discussion. Observation shows blubs that pop to the surface — this is probably methane, but it is carrying dissolved coal tar with it.

SECTION 5

Remedial Investigation

This section describes the overall approach, rationale, and data used for the RI activities at OU2. It includes a discussion of DQOs that were used as the basis for developing the scope and approach to the RI. Table 5-1 provides a summary of surface water, and sediments samples to be collected as part of this RI. The tables include the analytical parameters to be analyzed in each sample and the recommended sample depth. A detailed description of the sampling and analytical methods is presented in the FSP and QAPP in Appendixes A and B, respectively. Chemical analyses will be conducted by an EPA Certified Laboratory Program (CLP)-certified laboratory, or equivalent, that will provide CLP or SW846 data deliverable documentation necessary for data validation; the lab will also be NJDEP-certified. As part of the RI, a database will be developed and employed to present and analyze historic and new data. The RI scope of work is based on data gaps identified in existing characterization data at the Quanta Resources Site, which were discussed in Sections 2 and 3. The remainder of this section presents the DQOs along with the details of the investigation scope.

5.1 Data Quality Objectives

Data Quality Objectives (DQOs) were developed for this RI/FS WP following EPA guidance (EPA, 2006). The seven steps of the DQO process for the overall RI/FS WP are presented below.

Step 1. State the Problem

The Quanta Resources Site is located on the western shore of the Hudson River in Edgewater, New Jersey. Former industrial properties border the site on the north and south. The site was used for coal tar refining from 1930 to 1974, and waste oil reprocessing from 1974 to 1981 (Parsons, 2005). These activities led to the release of NAPL and other site-related chemicals to surface and subsurface soils, groundwater, and near-shore sediment adjacent to the site. The upland part of the site (OU1) is backfilled with 10 or more feet of non-native fill and has a wooden pile bulkhead along the shoreline. The offshore portion (OU2) includes intertidal and shallow subtidal sediments.

Existing data for OU2 indicate that NAPL occurs as lenses interbedded with silt, and that concentrations of PAHs in sediment are elevated in areas where NAPL is found. Concentrations of other chemicals appear to be either generally uniformly distributed, or highest adjacent to the bulkhead. Elevated concentrations of several chemicals were also found in sediment to the north of the Quanta Resources Site, adjacent to the former Lustrelon property. The extent of NAPL in OU2 was delineated in 1999 using CPT/ROST™ technology. This method, while the best available technology at the time, is not capable of differentiating various types of petroleum products or providing a detailed and refined interpretation of coal tar distribution. In addition to contaminants from the Quanta Resources Site, OU2 sediments may be affected by urban runoff and upstream and/or downstream sources of contamination. An RI/FS of OU2 is required to:

- Determine the lateral and vertical distribution and extent of PCOIs associated with releases from the Quanta Resources Site
- More accurately delineate the extent of coal tar in sediment
- Characterize the depositional environment adjacent to the site
- Characterize potential ecological and human health risks associated with exposure to contaminants from the site
- Obtain information to evaluate the most feasible options for managing sediments

General types of data needed to proceed with the RI/FS include chemical concentrations in surface sediment, subsurface sediment, surface water, and fish and/or shellfish tissue; detailed information on the distribution of coal tar, sediment stability and deposition rate, and data for physical characteristics of sediment.

Step 2. Identify the Goals of the Study

The following are the principal study questions for the OU2 RI/FS, potential alternative actions based on the answer to the question (for decision questions), and associated decision or estimation statements. The principal questions for the BERA and the Human Health Risk Assessment (HHRA) will be presented in a separate WP.

1. **Principal question:** What PCOIs are present in OU2 sediment at concentrations exceeding regional background levels, and are related to historical activities at the Quanta Resources Site?

Alternative actions: PCOIs that exceed regional background levels, are related to historical activities at the site, and contribute to unacceptable levels of ecological or human health risk will be the focus of remedial action objectives (RAOs) for OU2. Alternatively, PCOIs that do not meet these criteria are unlikely to be the focus of RAOs.

Decision statement: Determine whether PCOIs in OU2 sediment exceed regional background levels and are related to historical activities at the Quanta Resources Site.

2. **Principal question:** What are the lateral and vertical distribution and extent of coal tar and site-related PCOIs in OU2 sediment?

Estimation statement: Information about the distribution and extent of coal tar and site-related PCOIs in sediment are needed to evaluate potential ecological and human health risks, and to define the boundaries of the area to be evaluated in the risk assessments and FS. The objective of this RI is to identify the horizontal and vertical boundaries beyond which concentrations of site-related PCOIs do not exceed background threshold values, and coal tar is not present.

3. **Principal question:** What are the characteristics of the depositional environment in OU2?

Estimation statement: Information about the depositional environment will be used to refine the conceptual site model. Sediment erosion and deposition patterns will influence the development and evaluation of remedial alternatives for OU2, including dredging, capping, and monitored natural recovery.

4. **Principal question:** What are the physical characteristics of sediment that will influence the feasibility of various sediment management approaches? (estimation problem).

Estimation statement: Physical characteristics of sediment (grain size distribution, TOC content, moisture content, bulk density, strength and consolidation characteristics, and particle settling characteristics) will influence the conceptual design of remedial alternatives for sediment.

Step 3. Identify Information Inputs

The information needed to answer the principal study questions will be obtained through new data collection and from existing information:

- Analytical chemistry data for sediment samples collected from OU2 and upriver and downriver locations. Detection limits for the analytical parameters identified in Step 7 must be sufficient for performing risk assessments
- Sediment sample data from previous OU2 investigations
- Data for regional background concentrations of PCOIs in lower Hudson River sediment from other sources (i.e., literature, regional databases), as available
- Detailed analytical data for PAHs to support a "fingerprinting study" to differentiate PAHs originating from site-related coal tar from other sources of PAHs (e.g., urban runoff)
- TarGOST™ survey results
- Field data, such as sample coordinates and elevations, water depth and tide height, geologic description of sediment cores, field observations of coal tar seeps
- OU1 data and information regarding historical operations and environmental conditions
- Radioisotope profile data (cesium-137) for sediment cores in undisturbed areas to evaluate sediment stability and identify net sediment accumulation rate
- Scientific literature regarding hydrodynamics and sediment transport in the lower Hudson River
- Sample data for grain size distribution, TOC, moisture content, bulk density, Atterberg limits, self weight consolidation, permeability, and column settling tests

Step 4. Define the Boundaries of the Study

The target populations for this study are OU2 sediment that has been affected by releases from the Quanta Resources Site, and upriver and downriver sites that are not affected by measurable amounts of PCOIs from the Quanta Resources Site.

Existing sediment sample data from OU2 indicate that elevated PAH concentrations appear to be closely associated with the occurrence of NAPL. Concentrations of other PCOIs appear to be either uniformly distributed or highest adjacent to the bulkhead. Therefore, the study area will be bounded on the west by the shoreline and will extend to the east approximately 900 feet, and will extend upriver to approximately the location of the George

Washington Bridge and approximately 3.5 miles downriver. An area north of the former gypsum landfill adjacent to the former Lustrelon property will also be included in the study because elevated concentrations of some PCOIs were previously measured in this area (GeoSyntec, 2000).

Arxino

Sediment samples should be collected at a sufficient density to map PCOI concentration gradients, which are expected to be highest adjacent to the bulkhead and decrease to regional background levels with increasing distance from the shoreline. Sample density should also be sufficient to support the risk assessments and development of remedial alternatives. Evaluation of existing information on PCOI concentration gradients indicates that a surface sediment sample spacing of approximately 100 to 150 feet will meet these objectives.

The vertical boundary of the study area will be 50 feet for the TarGOST™ survey, which is expected to extend beyond the extent of coal tar, with the possible exception of one location where hydrocarbons were previously detected at a depth greater than 50 feet (GeoSyntec, 2000). Sediment samples will be collected to a depth of 30 feet using a Vibracore. If coal tar is detected at depths of greater than 30 feet, an attempt will be made to collect deep sediment samples with the Geoprobe rig used for the TarGOST™ survey.

Subsurface sample data should represent smaller depth intervals in shallower sediment to increase its utility for risk assessment purposes. Deeper sediments can be represented by larger intervals to provide a broad indication of the vertical extent of contamination.

step 7 says only 1 sample

Therefore, subsurface samples will represent 0.5-foot intervals in the top 1 foot of sediment, a 1-foot interval from 1 to 2 feet below the mudline, and 2-foot intervals below 2 feet (sample intervals are described in more detail in Step 7).

If site-related contamination is found to extend beyond the lateral or vertical study boundaries, or if more detailed lateral or vertical characterization is needed in specific areas, the data gaps will be identified and a supplemental investigation will be implemented as needed.

*.5
1
2
4
6*

Upriver and downriver sampling locations will be collected at locations along the western shore of the river in areas that appear to be physically similar to the Site. Samples will be collected at these locations and analyzed for the same physical and chemical constituents as the Site samples. After the sampling results are received the suitability of these samples for use as possible reference samples will be evaluated based on the following criteria: 1) grain size distribution and TOC content expected to be similar to the study area; 2) salinity and hydrodynamic conditions similar to the study area; 3) habitat characteristics similar to the study area to the degree possible; and 4) based on the conceptual site model, locations expected to be representative of regional conditions in the lower Hudson River, with the exception of the absence of measurable quantities of chemicals from the Site.

Step 5. Develop the Analytic Approach

A weight-of-evidence approach will be used to identify site-related PCOIs in sediment. If multiple lines of evidence point to a similar conclusion, then the degree of confidence in the conclusion will be increased. The following lines of evidence will be considered:

- If PCOI concentrations in OU2 sediment samples exceed regional background threshold values, then they may be considered site-related. The general approach for establishing background threshold values for sediment will be as follows:
 - Compile the upriver and downriver sample results and statistically evaluate the data for the presence of outliers. Remove statistical outliers from the data set. PAH fingerprinting data for upriver and downriver sediment samples also will be used to evaluate whether the location is potentially affected by PAHs from the Quanta Resources Site.
 - The background threshold values will be determined as either a specified percentile of the background distribution, or as an upper tolerance limit (UTL) of the distribution (e.g. the 95% confidence limit on the 95th percentile), depending upon the suitability of the data to support the calculation.
 - After suspect data points are removed from the data set, a one-tailed 95 percent upper prediction limit (UPL) for each chemical will be computed. The 95 percent UPL is a statistically derived confidence bound that is 95 percent certain to contain all possible background results. Background threshold values for each chemical will be the 95 percent UPL or the highest potential background value, whichever is lower.
 - Calculated background threshold values will be compared with available information about regional concentrations of PCOIs in the lower Hudson River to verify that they are reasonable estimates of regional background concentrations.
- If the PAH fingerprint in a sediment sample is indicative of a coal tar source, the PAHs may be site-related. Conversely, if the PAH fingerprint is consistent with urban runoff or other hydrocarbon sources not related to Quanta Resources Site activities, the PAHs may not be site-related.
- If PCOIs are related to historical operations at the Site and sample results are consistent with the conceptual site model for OU1, they will be considered site-related.
- If PCOI concentration gradients in sediment indicate that OU1 is the source of contamination to OU2, they will be considered site-related.

TarGOST™ survey results will be used to map the horizontal and vertical extent of coal tar in OU2 sediment. OU2 sediment sample analytical data and results from previous investigations will be compared with background threshold values on a point-by-point basis and used to map the distribution and extent of PCOIs above background threshold levels. Field observations will be used to broadly define the extent of coal tar seeps.

Cesium-137 activity will be plotted with increasing depth in the sediment core from three locations away from the bulkhead and piers where sediments may be less disturbed. The first appearance of Cesium-137 will be determined to approximately represent the 1954 time horizon, when atmospheric testing of nuclear devices was initiated. The shape of the Cesium-137 profile will be used to evaluate the degree of physical mixing of the sediment column: if the profile shows a distinct subsurface peak, then the sediment column will be considered relatively stable. A disrupted or uniform activity profile will indicate a more dynamic depositional environment or anthropogenic disruption (e.g., dredging).

Physical data for sediment samples (grain size distribution, TOC, moisture content, bulk density, Atterberg limits, self weight consolidation, permeability, and column settling) will be used to calculate summary statistics (minimum, maximum, median, and mean). The results will be used to evaluate the potential effectiveness of various sediment management approaches for consideration in the FS.

Step 6. Specify Performance Criteria

An important objective of this investigation is to ensure that the nature and extent of contamination attributable to the Site is defined. The OU2 sediment sample analytical results will be compared with the background threshold values on a point-by-point basis to determine the extent of site-related contamination. Therefore, the baseline condition (or null hypothesis) will be established as the PCOI concentration in the OU2 sediment sample exceeds the background threshold value. The alternative condition (or alternative hypothesis) is the PCOI concentration in the OU2 sediment sample does not exceed the background threshold value.

To avoid incorrectly concluding that OU2 PCOI concentrations are below background threshold values when in fact they are above them (i.e., false rejection decision error), background threshold values will be calculated with a high degree of confidence (i.e., 95% confidence level, depending on the suitability of the data to support the calculation). Additionally, care will be taken to ensure that the background site analytical data set does not include samples that appear to be affected by sources from the Site. As described in Step 5, suspect results (i.e., statistical outliers or samples from locations that have a PAH fingerprint consistent with coal tar from the Site) will be removed from the data set, and calculated background threshold value will be compared to published information for regional chemical concentrations in the lower Hudson River.

The basis for the PAH fingerprinting study and associated performance criteria are presented in the PAH Fingerprinting Study Work Plan Addendum.

Performance criteria for addressing potential measurement error are specified in the, Field Sampling Plan and Quality Assurance Project Plan, Appendixes A and B, respectively.

Step 7. Develop the Plan for Obtaining the Data

A stratified grid sample design will be used in the OU2 study area to characterize sediment quality. Two strata have been defined: A) from the shoreline of the Site to approximately 400 feet offshore, where PCOI concentrations are expected to be highest and concentration gradients are expected to be greatest, including the area south of the Spencer Kellogg Pier; and B) the area to the north and east of the A grid, where PCOI concentrations are expected to be more uniform and similar to regional background levels. A denser grid for the A grid is desired to support remedial planning because this is the area most likely to require sediment management.

A systematic grid sampling approach will be used as follows:

- A: systematic grid, approximate 100-foot spacing, 47 sample locations
- B: systematic grid, approximate 150-foot spacing, 30 sample locations

The TarGOST™ survey will be conducted at all 47 locations in the A grid, and at all stations previously characterized using CPT/ROST™ technology. The TarGOST™ survey will be conducted to a depth of 50 feet. If the lateral extent of coal tar extends beyond the A grid or is detected at previous CPT/ROST™ stations in the B grid, the survey will be conducted in the B grid. If the lateral or vertical extent of coal tar goes beyond these boundaries, recommendations for further characterization will be formulated as appropriate.

The surface and subsurface sediment sample design is as follows:

- Surface samples will be collected at every grid station at a depth of 0-0.5 foot.
- Subsurface samples will be collected at a subset of stations: 8 stations in the A stratum and 6 stations in the B stratum. Core samples will be equally distributed (i.e., evenly spaced) throughout the A and B strata, but may be adjusted based on the results of the TarGOST™ survey; cores will not be collected in areas of heavy NAPL contamination.
- Subsurface samples will represent the following composite intervals: 0.5-1.0 foot, 1-2 feet, 2-4 feet, 4-6 feet, 6-8 feet, 8-10 feet, 12-14 feet, 16-18 feet, 22-24 feet, and 28-30 feet. The 2-foot composite samples from the remaining intervals deeper than 10 feet (e.g., 10-12 feet, 14-16 feet, 18-20 feet, 20-22 feet, 24-26 feet, and 26-28 feet) will be archived frozen for potential future analysis. (0-0.5)
- Sediment samples will be collected at selected intervals from each TarGOST™ location to visually confirm the presence/absence of coal tar detected by the TarGOST™ instrument. If coal tar is detected at depths greater than 30 feet, an attempt will be made to collect sediment samples with the Geoprobe rig to evaluate the vertical extent of sediment contamination. This sample will be submitted to the laboratory for SVOC, PCB, and metals analysis (like all other sediment analytical samples) to assess the presence or absence of residual sediment contamination at depth.
- Samples from three cores will be analyzed for Cesium-137. The three cores will be located along a transect perpendicular to the bulkhead at distances of approximately 275 feet, 475 feet, and 750 feet. Cores will be collected to a depth of 15 feet because of the possibility of high sedimentation rates adjacent to the Site. Sediment samples for Cesium-137 analysis will be collected in 2-inch increments to the base of the core. Initially, samples from 1 foot intervals will be submitted to the laboratory for analysis to broadly define the vertical extent of Cesium-137 activity. Additional intervals will be subsequently submitted for analysis to refine the activity profile.
- Surface sediment samples will be collected at five locations north of the former gypsum landfill, where elevated levels of PAHs were previously detected. Surface sediment samples (0-0.5 foot) will be collected at all five locations, and a sediment core will be collected at one station. Subsurface samples will be collected at depths of 0.5-1.0 foot, 1-2 feet, and 2-4 feet. / Arsenic
- Surface sediment samples will be collected from 20 upriver and downriver locations (10 upriver and 10 downriver). Proposed background locations were selected based on the criteria presented in Step 4.

Sediment samples will be analyzed for VOCs, SVOCs, PCBs, PCB congeners, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size distribution, and TOC. VOC analysis will be completed on samples within the A grid because VOC concentrations are expected to be measurable closest to the source areas. PCB congener analysis will be completed at each of the 14 Vibracore locations in the 0-0.5 foot and 0.5-1 foot intervals. Based on historic results from OU1 and OU2 pesticides will not be analyzed for in sediment samples. (Note that samples collected for the BERA will be analyzed for a broader list of analytes including pesticides).

A subset of samples will be analyzed for additional PAHs to support chemical fingerprinting. Sample numbers and locations for fingerprinting and analytical parameters are specified in the PAH Fingerprinting Study Work Plan Addendum.

Sediment samples from depths of 0-0.5 foot, 0.5-1.0 foot, 2-4 feet, 12-14 feet, and 22-24 feet that are collected at each core sample location will be analyzed for the physical parameters specified in Step 3.

Sediment sampling will not be conducted during active dredging operations in the Hudson River that are nearby the Site.

Scope of work details to satisfy the DQOs are presented below.

5.2 Summary of RI Scope

5.2.1 Background Research and Assessment

A background reference area, as indicated by EPA guidance, should have the same physical, chemical, geological, and biological characteristics as the site being investigated, but should not be affected by activities from the site (EPA, 2002).

Surface sediment samples (0-0.5 feet) will be collected from similar tidal flat habitats upstream and downstream of the site to the degree possible. Additional up and downstream samples may be collected from areas that do not meet the criteria of a reference location (not similar habitat) but may be important sampling locations to discriminate sources of PAHs. At some of the up and downriver sampling locations, PAH fingerprinting techniques will be employed to assess the presence of site-related coal tar (details of the fingerprinting study will be provided in an addendum to this WP). The upriver and downriver locations will be evaluated for potential suitability as reference locations for the BERA and HHRA. See Figure 5-2 for proposed upstream and downstream river sample locations. Final decisions on the selection of reference locations for the BERA and HHRA will be made in consultation with the EPA team. Data from the upriver and downriver locations will be used for establishing background threshold values, as described in Step 5 of the DQOs.

The following criteria will be used in selecting reference samples:

- Samples will be collected within the same watershed.
- Samples will be of similar substrate with the similar grain size and TOC content.
- Locations will have similar salinity and hydrodynamic conditions as the study area.

✓ Cant read anything on fig 3-1
Arsenic Speciation

- Locations will have similar habitat characteristics.
- Samples will not be collected near a known outfall or point source of contamination (e.g., a known contaminated site, which will be mapped in relation to proposed reference locations).
- Regional sediment analytical data will be considered in selecting a reference location.

5.2.2 Sediment Sampling

Sediment samples will be collected from OU2 for chemical, geotechnical, and age dating characterization (Figure 5-1 and 5-2 and Table 5-1).

To determine the horizontal and vertical extent of impacts within OU2, sediment sampling locations will be established using a stratified grid approach (Figure 5-1). Grids will be established around two areas: Area A (in front of OU1 and south of the Spencer Kellogg pier) and Area B (away from the site to the north and south along the river). Prior to sampling a base map will be created of the sediment surface for the entire study area. This mapping will be completed using multibeam bathymetry and side scan sonar. Within Area A, surface sediment grab samples (0-0.5 foot) will be collected on an approximate 100-foot grid at 47 locations. Within Area B, surface sediment grab samples (0-0.5 foot) will be collected on an approximate 150-foot grid at 30 locations, for a total of 77 locations.

Sediment Vibracore sampling will be conducted at 14 of the 77 surface sediment locations—8 from Area A and 6 from Area B (Figure 5-1). Sediment cores will be collected continuously to a depth of 30 feet using a Vibracore sampler. Sediment samples will be collected for chemical analysis at the following with intervals: 0-0.5 foot, 0.5-1.0 feet, 1-2 feet, 2-4 feet, 4-6 feet, 6-8 feet, 8-10 feet, 12-14 feet, 16-18 feet, 22-24 feet, and 28-30 feet). All surface sediment samples in areas A and B and all Vibracore samples will be analyzed for SVOCs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size distribution, and TOC. All surface sediment samples and Vibracore samples in the Area A grid will also be analyzed for VOCs as measurable concentrations of VOCs are expected closest to the site. PCB congener analysis for the full 208 congeners will be completed on samples collected from the 0- 0.5 and 0.5-1 foot intervals at the 14 Vibracore locations. Sampling procedures and quality assurance/quality control (QA/QC) procedures are outlined in the FSP and QAPP (Appendix A and Appendix B, respectively).

At all grid locations, TarGOST™ will be used to delineate NAPL to 50 feet (if feasible). The TarGOST™ probe will be employed with a Geoprobe tool. If the TarGOST™ tool indicates positive signals for coal tar at depths below 30 feet, an attempt will be made to collect confirmatory samples with a Macrocore™ sampler attached to the Geoprobe. It is possible that subsurface conditions may inhibit use of TarGOST™ to 50 feet at some locations or may inhibit the collection of confirmatory samples. If this occurs, data gaps will be identified and a supplemental investigation will be implemented as needed. In addition to the grid points, the previous ten CPT/ROST™ locations will be re-screened using TarGOST™ to verify previous results (See Figure 5-1). The TarGOST™ survey, combined with analytical results, will be used to determine the depth of contamination. Procedures for conducting the TarGOST™ survey and the different types of sediment sampling are outlined in the FSP (Appendix A).

As discussed
 Elevated levels of PAHs were previously encountered in samples collected from the embayment north of the former gypsum landfill area (GeoSyntec, 2000). As a result, an additional five surface sediment samples will be collected north of the former gypsum landfill. One of these surface sediment samples will be selected for vertical profiling via Vibracore boring with samples collected from 0.5-1 feet, 1-2 feet, and 2-4 feet. See Figure 5-1 for the location of these samples.

The depositional history of OU2 will be characterized using a combination of sediment sampling data collected within the vicinity of the site, as well as information from scientific literature. Three Vibracore locations will be selected for high-resolution time dating profiles via Cesium-137 radioactive isotope analysis method. The procedures for evaluating current and historical sediment deposition at OU2 are described in the FSP (Appendix A):

5.2.3 Surface Water Investigation

As discussed in the May 2 and July 13, 2006 meetings surface water samples will not be collected as part of the initial RI field effort. Sampling of surface water will be completed as part of the BERA field event for use in the BERA and BHHRA. The study will be designed after available OU1 data can be assessed. Data collected as part of the OU1 investigation will answer questions related to the vertical and horizontal extent and orientation of confining layers and water-bearing zones immediately adjacent to the river. This information will be used to target groundwater discharge zones and locations for surface water sampling.

5.2.4 Ecological Risk Assessment

Based on the results of the ERA conducted for OU2 in August 2000 by Lockheed-Martin for EPA (summarized in Section 3.4), further evaluation of potential ecological risk will be conducted to reduce the uncertainty and to fill data gaps. This work will be completed as a Baseline Ecological Risk Assessment which will incorporate the RI data but will also require the collection of specialized data. The overall approach to the BERA is summarized below; however, specifics of the BERA will be presented in a separate BERA Work Plan, which will be submitted to EPA 60 days after receipt of the OU2 RI field data, and concurrence on reference locations is received from EPA.

The BERA will be conducted in accordance with the current EPA guidance (ERAGS) (EPA, 1997). A draft BERA will be submitted to EPA within 45 days of completion of the final set of BERA-related validated analytical data. The Draft BERA will be conducted to assess actual and potential ecological risks to the environment associated with the media identified in the EPA ERA (EPA, 2000). EPA's Proposed Guidelines for Ecological Risk Assessment and other relevant EPA guidance documents will be followed while conducting the BERA. The draft BERA report will discuss:

- Hazard Identification (sources). Available information on the hazardous substances present at the site will be reviewed and the major PCOIs will be identified.
- Dose-Response Assessment. PCOIs will be identified and selected for risk evaluation based on their intrinsic toxicological properties.
- Characterization of potential receptors and environmental exposure pathways.

- Chemicals, indicator species, and end points identification.
- Exposure Assessment. The magnitude of actual environmental exposures, the frequency and duration of these exposures, and the routes by which receptors are exposed. The exposure assessment discussion will include the likelihood of such exposures occurring and will provide the basis for the development of acceptable exposure levels. Reasonable maximum estimates of exposure for both current land use conditions and potential land use conditions at the site will be described.
- Toxicity Assessment/Ecological Effects Assessment. The toxicity and ecological effects assessment discussion will focus on the types of adverse environmental effects associated with chemical exposures, the relationships between magnitude of exposures and adverse effects, and the related uncertainties for contaminant toxicity.
- Risk Characterization. During risk characterization, chemical-specific toxicity information, combined with quantitative and qualitative information from the exposure assessment, will be compared to measured levels of contaminant exposure levels and the levels predicted through environmental fate and transport modeling. These comparisons will determine whether concentrations of contaminants at or near the site are affecting or could affect the environment.
- Identification of Limitations/Uncertainties. Critical assumptions and uncertainties will be discussed.
- Site Conceptual Model. Based on contaminant identification, exposure assessment, toxicity assessment, and risk characterization, a conceptual model of the Site will be presented.

The BERA will evaluate the potential risks to the benthic community described in the ERA (EPA, 2000). Additional sampling for the BERA, such as benthic community surveys and toxicity testing, needed to address data gaps and uncertainties inherent to the previous ERA, will be described in the BERA Work Plan. To address an additional data gap, food chain modeling will be conducted to determine if there is a risk to piscivorous and omnivorous birds and omnivorous mammals that utilize the tidal flat area for foraging. Consistent with a BERA, central tendency estimates (rather than high-end or maximums) for exposure parameters such as ingestion rates and biotransfer factors will be used. Tissue samples from fish and shellfish will be collected to support the food chain modeling.

Fish exposure through ingestion of prey items will not be modeled in the BERA because of a lack of input parameters for carnivorous fish, such as ingestion rates, toxicological data, and the large home range/transient nature of predatory species in this area. To the extent possible, risk to fish will be evaluated in the BERA by calculating or collecting tissue concentrations from resident species and comparing the measured tissue concentrations to literature-based tissue values associated with adverse effects. Surface water concentrations will also be compared to water quality criteria intended to be protective of all fish exposure pathways, including ingestion (e.g., National Ambient Water Quality Criteria).

The Draft BERA report will be revised in response to EPA comments and a final BERA report will be submitted within 45 days.

5.2.5 Human Health Risk Assessment

A Baseline HHRA (BHHRA) for OU2 will be prepared. The BHHRA will be completed on the same schedule as the BERA as critical data collected as part of the BERA (such as tissue data and pore water) will be needed to complete the BHHRA. The BHHRA will identify potential cancer risks and non-cancer hazards to human health in accordance with CERCLA, the NCP, and relevant EPA guidance. During development of the BHHRA, several intermediate deliverables will be prepared and submitted to EPA, as identified below.

A memorandum on exposure scenarios and assumptions based on the present and reasonably anticipated future land use of the site will be completed within 45 days after approval of this RI/FS work plan. The memorandum will present the CSM, exposure routes of potential concern, and contain identified pathways [Risk Assessment Guidelines for Superfund (RAGS) Part D Table 1]. The memorandum will also include a discussion of exposure parameters for identified pathways (RAGS Part D Table 4) with reference to EPA's 1991 Standard Default Assumptions and updated EPA guidance.

Within 45 days after receipt of the last set of validated analytical data collected as part of the BERA field work, a Pathway Analysis Report (PAR) describing the BHHRA process will be completed and submitted to EPA. The PAR will be developed in accordance with the guidelines set forth in the RAGS Part D and other appropriate EPA guidelines. The PAR will identify human health related PCOIs (Table 2), media-specific exposure point concentrations (Table 3), and toxicological information (Tables 5 and 6) for identified PCOIs. Completed RAGS Part D Tables 2, 3, 5, and 6 will be included in the PAR. The PAR must be reviewed and approved by EPA prior to completion and submittal of the draft BHHRA.

Within 45 days of approval of the PAR, a draft BHHRA will be completed. The BHHRA will be performed to assess potential exposure and risk to human health associated with site sediment, surface water, and edible fish/crab tissue. The BHHRA will be conducted in accordance with CERCLA, the NCP, and EPA guidance, using the approach and parameters described in the approved memorandum of exposure scenarios and assumptions and the PAR. The BHHRA will include the EPA-approved RAGS D Tables 1 through 6 presented in the exposure scenario memorandum and the PAR, completed RAGS Part D Tables 7 through 10 summarizing potential cancer risk and non-cancer hazards, and appropriate text in the risk characterization section describing the uncertainties and critical assumptions.

The BHHRA will include:

- Identification of and evaluation of the PCOIs detected in surface water, sediment, and edible tissue at the site, using all currently available media-specific analytical data generated during the RI and BERA.
- Exposure assessment – Identification of the potential receptors under the current and future scenarios and identification of the potentially complete exposure pathways for each potential receptor.
- Toxicity assessments – Discussion of toxicological properties of the PCOIs.
- Risk characterization – Estimation of the total cancer risk and target organ-specific hazard index for each potential receptor.

- Uncertainty analysis – Identification of the major uncertainties involved in the data collection, exposure assessment, toxicity assessment, and risk characterization steps of the BHHRA.

5.3 Reporting

5.3.1 Data Validation Report

The chemical analyses will be conducted by an independent EPA CLP-certified and NJDEP-certified laboratory. Data validation will be performed using the guidelines set forth in the EPA Region II CERCLA Data Validation Standard Operating Procedures (<http://www.epa.gov/region02/desa/hsw/sops.htm>), EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA, 1999), and EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA, 2002). The data validation will include an initial review to verify completeness of laboratory documentation, and a quality assurance review that will include assessment of relevant standards identified in the QAPP (Appendix B). Data qualifiers consistent with the EPA Region II QA guidance will be assigned as necessary to analytical results tabulated in data tables. Validated analytical data will be submitted within 45 days of each sampling activity event (i.e., the initial proposed field investigation event). Results of the data validation will be summarized in an appendix to the RI report.

5.3.2 Preliminary Site Characterization Report

A Preliminary Site Characterization Report will be prepared after completing the field sampling and analysis and will be submitted to EPA within 30 days of validation of the final set of field data. The report will contain a review the investigation activities and describe and display the data from OU2. It will document the location and characteristics of subsurface features and contamination, including the affected medium, location, physical state, concentrations of contaminants, and quantity. It will also document the location, dimensions, physical condition, and varying concentrations of PCOIs and the extent of migration. Within 14 days after submittal of the PSCR, a presentation will be made to EPA and the State on the findings of the report. The PSCR will provide EPA with a basis for the development of the risk assessment, evaluation of the development and screening of remedial alternatives, and identification and refinement of Applicable or Relevant and Appropriate Requirements (ARARs). The PSCR will identify any remaining data gaps to complete the RI.

5.3.3 RI Report

The RI report will describe the characteristics of OU2, including impacted media, and nature and extent of contamination. The RI will also summarize the results of the field activities, sources of contamination, and fate and transport of contaminants. Analytical data will be presented in summary tables. Key findings will be presented on site maps. The RI report will be written in accordance with the *Guidance for Conducting Remedial Investigations / Feasibility Studies under CERCLA*, OSWER Directive 9355.3-01, October 1988, Interim Final (or latest revision), and *Guidance for Data Usability in Risk Assessment*, (EPA/540/G-90/008, September 1990 (or latest revision)). The RI report will be divided into the following sections:

- Section 1 – Introduction, including purpose and background, relevant previous investigation results, and a summary of risk assessment results
- Section 2 – Scope of Work, including data collection methods and deviations from the Work Plan
- Section 3 – Physical Characteristics of the Site, including surface features, hydrology, geology, etc.
- Section 4 – Nature and Extent of Contamination, including potential sources, analytical results including tabular summary data table with applicable standards, criteria, or guidance values, and contamination assessment
- Section 5 – Contaminant Fate and Transport, including potential routes of migration, persistence, and migration and preliminary identification of ARARs applicable to the various media of concern
- Section 6 – Summary, Conclusions, and Recommendations. Draft and Final RI reports will be prepared for distribution to EPA. The final RI report will include amendments that are responsive to the directions provided in EPA comments on the Draft RI

SECTION 6

Feasibility Study Scope

This section describes the overall approach for conducting the feasibility study at OU2 (Hudson River portion).

6.1 Identification of Candidate Technologies

An Identification of Candidate Technologies Memorandum will be prepared and submitted to EPA within 30 days of the submission of the last set of validated analytical results for the RI field work to EPA. The Memorandum will include a listing of candidate technologies required for alternative analysis, and will include innovative treatment technologies (as defined in the RI/FS Guidance) where appropriate. The Identification of Candidate Technologies Memorandum will be revised based on EPA comment.

6.2 Treatability Studies; As Necessary

At the EPA's request, treatability testing may be performed to assist in the detailed analysis of the alternatives. The testing results may be used in the detailed design of the selected remedial alternative. The treatability study activities will include the items described below.

Literature Survey and Determine Need for Treatability Testing – A literature survey will be conducted to gather information on performance, relative costs, applicability, removal efficiency, operations and maintenance requirements, and implementability of candidate technologies. If practical candidate technologies can not be sufficiently demonstrated, or can not be adequately evaluated, treatability testing will be conducted. If EPA determines that treatability testing is required, and it can not be demonstrated that treatability testing is not needed, a statement of work outlining the steps and required data will be prepared and submitted to EPA.

Evaluate Treatability Studies – A decision will be made on the type of treatability testing (e.g., bench vs. pilot testing) to use for OU2 based on discussions with the EPA. The decision to perform a pilot scale treatability testing should be made as early as possible, given the time constraints associated with obtaining the equipment and conducting the testing. A separate treatability testing work plan or an amendment to the original site work plan will be submitted for EPA review and approval.

Treatability Testing and Deliverables – The deliverables that will be prepared if treatability testing is conducted include the following: treatability testing statement of work, a work plan, a sampling and analysis plan, a final treatability evaluation report, and if appropriate, a treatability study health and safety plan. The Treatability Testing Statement of Work will be submitted within 14 days of notification by EPA that treatability testing is required.

Treatability Testing Work Plan – A Treatability Testing Work Plan and schedule will be submitted within 30 days of written EPA approval of the Treatability Testing Statement of Work. The Treatability Testing Work Plan will be amended in response to directions in EPA comments. The Work Plan will describe the background of the Site, remedial technology(ies) to be tested, test objectives, experimental procedures, treatability conditions, measurement of performance, analytical methods, data management and analysis, health and safety, and residual waste management. The DQOs for the treatability testing will also be documented.

Treatability Study QAPP – A separate or revised QAPP will be submitted within 30 days of identification by EPA of the need for a separate or revised QAPP. If the original QAPP is not adequate for defining the activities to be performed during the treatability test, a separate treatability study QAPP, or revision to the original QAPP, will be prepared for EPA review and approval. The new QAPP will be revised based on EPA comments.

Treatability Study Health and Safety Plan – A separate or revised HSP will be submitted within 30 days of identification by EPA of the need for a separate or revised HSP. If the original HSP is not adequate for defining the activities to be performed during the treatability test, a separate treatability study HSP, or revision to the original HSP, will be prepared.

Treatability Study Evaluation Report – A treatability Evaluation Report will be prepared and submitted to EPA within 30 days of completing the treatability testing. Following the completion of treatability testing, the testing results will be analyzed and interpreted and a report prepared. The report will evaluate each technology's effectiveness, implementability, cost and actual results as compared with predicted results. The report will also evaluate full scale application of the technology. The report may be part of the RI/FS or a separate deliverable. The Treatability Testing Report will be revised based on EPA comments.

6.3 Development and Screening of Remedial Alternatives

Concurrent with the OU2 RI characterization, a range of appropriate remedial and waste management options that will at a minimum protect human health and the environment will be developed and evaluated. The development and screening of remedial alternatives will provide an appropriate range of waste management options that will be evaluated. The following activities will be performed during the development and screening of alternatives.

Identification of ARARs – This task includes the identification of applicable and ARARs. Federal and state criteria, advisories, guidance that are applicable to the various media of concern at the Site will be identified. Action specific, chemical specific, and location specific ARARs will be determined once site specific data is obtained and evaluated in the RI.

Establish Remedial Action Objectives – RAOs will be developed for the media found to be impacted, specifying the chemicals of concern, exposure pathways, receptors and remediation goals. These objectives will be based on contaminant specific cleanup criteria and ARARs. The guidance for cleanup criteria will include state and federal criteria. EPA will be consulted during this phase of study for input concerning cleanup objectives, and a meeting with EPA will be held early in the FS to review RAOs and preliminary alternatives.

The remedial action objectives described in the FS report will be based on site-specific considerations.

Develop General Response Actions – General response actions are described as those actions that will satisfy the remedial action objectives. These response actions may include monitored natural recovery, capping, dredging or excavation followed by disposal, or a combination of these actions. General response actions will be developed for all media of interest.

Identify Areas and Volumes of Media – Based on the results of the RI efforts and specific remedial action objectives, the areas requiring remedial action will be estimated. Areas or volumes of media to which the general response actions may apply will be identified. These areas or volumes will take into account requirements for protectiveness as identified in the remedial action objectives. The chemical and physical characterization of the Site will also be taken into consideration.

Assemble and Document Alternatives / Preliminary Screening – Selected representative technologies will be assembled into alternatives for each affected medium or operable unit. A summary of the assembled alternatives and their related action-specific ARARS will be prepared for inclusion in a technical memorandum. Selected alternative may be eliminated during preliminary screening process. The preliminary screening of the alternatives will consider both effectiveness and implementability. Effectiveness will include an evaluation of the action from the following perspectives:

- Ability to meet the ARARs and protect human health and the environment
- Ability to significantly and permanently reduce contaminant toxicity, mobility or volume
- Ability to provide a permanent solution or remedy and thereby limit operation and maintenance requirements
- Technical reliability
- Demonstrated performance
- Ability to comply with federal, state and local laws and regulations

Implementability will include the following:

- Constructability (technical and administrative feasibility)
- Concerns for worker and public health and safety during construction
- The period of time for the alternative to become operational and effective
- Availability of components or treatment facilities

Innovative alternatives will be carried through this screening if these actions offer a potential for better treatment performance or implementability, fewer adverse impacts, or lower costs than demonstrated technologies.

Technical literature and information available from manufacturers about the performance, costs, applicability and implementability of candidate technologies will be assessed. The need for treatability testing will be documented from the available literature and other information.

Development and Screening of Alternatives Presentation and Technical Memorandum -

Within 30 days upon EPA's request, a presentation to EPA and the State will be made that identifies the remedial action objectives and summarizes the development and preliminary screening of remedial alternatives. In addition, a Development and Screening of Remedial Alternatives technical memorandum summarizing the work performed in and the results of the development and screening process, including an alternatives array summary.

Refine Alternatives - Any information required to more completely refine the alternatives that remain after preliminary screening and to allow evaluation of each alternative will be developed. The remedial alternatives will be refined to identify contaminant volume addressed by the proposed process, preliminary design calculations, process flow diagrams, sizing of key process components, preliminary site layouts, and knowledge of limitations, assumptions, and uncertainties concerning each alternative. PRCs for each chemical in each medium will be modified as necessary to incorporate any new risk assessment information presented in the baseline risk assessment report.

Conduct and Document Screening Evaluation of Each Alternative - A final screening of alternatives may be performed based on short and long term aspects of effectiveness, implementability, and relative cost. If there are many alternatives available for detailed analysis, then final screening will be performed to narrow the list of potential remedial actions for the detailed alternatives evaluation effort.

Detailed Analysis of Remedial Alternatives - A detailed analysis of the remedial alternatives to provide EPA with the information needed to allow for the selection of a remedy for the Site. Individual alternatives will be evaluated against nine evaluation criteria. Cost estimates will also be prepared using conservative estimates of material quantities to treat based on available sample results. Cost estimates will be accurate to approximately plus or minus 30 to 50 percent. The detailed analysis of individual alternatives will include the following evaluation criteria:

- Overall Protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume
- Short-term impacts and effectiveness
- Implementability
- Cost
- State (or support agency) acceptance
- Community acceptance

In addition, a comparative analysis will be conducted to evaluate the relative performance of each alternative in relation to each specific evaluation criterion. This analysis is in contrast to the preceding analysis in which each alternative was analyzed independently without the consideration of interrelationships between alternatives. This comparative

analysis will identify the advantages and disadvantages of each alternative relative to one another so that the key tradeoffs to be evaluated by the decision maker can be identified.

A technical memorandum will be prepared that summarizes the results of the comparative analysis.

Select Recommended Remedy – Based on the detailed evaluation, a remedy will be recommended that is protective of public health and the environment, meets the applicable or relevant and appropriate regulatory requirements and cleanup objectives that have been identified to the maximum extent practicable, is cost-effective, reflects consideration of the preference for treatment rather than disposal, and represents the best balance of all evaluation criteria and considerations acceptable. The EPA will be responsible for selection of the final remedial alternative.

6.4 Feasibility Study Report

A FS report will be prepared that will summarize the site characterization data, document the recommendation(s) made, and describe all preceding FS tasks. The report will consist of a detailed analysis and a cost-effectiveness analysis, in accordance with the NCP, as well as the most recent guidance. The report will describe the remedial technologies and alternatives that were evaluated and the rationale for selection. The most feasible alternative, along with its projected cost and regulatory impact will be identified. The FS report will be prepared in accordance with "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA" (EPA, 1988). The FS report will contain the following sections listed below:

- Section 1: Introduction - Includes site background and project objectives, including a description of the field activities carried out as part of the site investigation, site characteristics such as geology, hydrogeology, meteorology, surface features, the nature and extent of contamination, and contaminant fate and transport.
- Section 2: Identification and Screening of Technologies - This section will summarize the feasibility study and remedial objectives, and ARARs along with the technology screening.
- Section 3: Development and Screening of Alternatives - This section will identify general response actions and describe screening of the remedial technologies considered for the Site. It will also present a description of the remedial alternatives.
- Section 4: Detailed Analysis and Ranking of Alternatives - The alternatives are analyzed and ranked.
- Section 5: Recommended Remedy.

A Draft FS Report will be submitted to EPA for review within 30 days of EPA acceptance of the presentation that identifies the remedial action objectives and summarizes the development and preliminary screening of remedial alternatives.

Within 14 days of submitting the Draft FS Report, a presentation summarizing the finding of the Draft FS report will be made to the EPA and the State.

A Draft Final FS Report will be prepared based on EPA's comments. The Draft Final FS Report will be submitted to EPA and made available to the public for review. A written response to comments, addressing EPA and public comments on the Draft FS Report, will be prepared.

After the public comment period on the Proposed Plan has been completed, if a revision to the Draft Final FS Report is required, the Final FS Report will incorporate the comments from EPA and the public.

SECTION 7

Project Organization

Several organizations will be involved directly in the performance and review of this project. These organizations have specific project functions and relate to each other according to their project responsibilities. The purpose of this section is to provide an understanding of the overall project organization and the function and responsibility of various groups to aid in the exchange of information and to ensure efficient project operation. The key organizations and their responsibilities are described below and shown in Table 7-1.

7.1 Environmental Protection Agency

Honeywell has entered into an Administrative Order on Consent with EPA to conduct an RI/FS at OU2 at the Quanta Resources Site. EPA will review and approve the RI/FS WP, FSP, QAPP, and HSP as specified in the SOW Order. The EPA has designated Mr. Richard Ho as the agency's Project Manager.

7.2 Respondent

Honeywell is the Respondent for the Quanta Resources Site OU2. The Respondent is responsible for the RI/FS. The Respondent has designated Mr. Tim Metcalf of Honeywell as the Designated Project Coordinator and primary contact for this project.

7.3 CH2M HILL

The CH2M HILL management and technical staff required to execute this project and their areas of responsibility are identified below. The responsibilities of key personnel are further described as follows:

Honeywell Program Manager

Mr. Jim Strunk is the Honeywell Program Manager. He is responsible for contact with Honeywell for corporate matters. Mr. Strunk is ultimately responsible for the performance of the CH2M HILL project team and the quality of work.

Project Manager

Mr. Steve Zarlinski will be the Project Manager (PM) for this project. Mr. Zarlinski will be responsible for the overall project performance (financial, schedule, staffing), conflict resolution and change management. Mr. Zarlinski will communicate with the Designated Project Coordinator, external stakeholders, and the Honeywell Program Manager for CH2M HILL. Mr. Zarlinski will help the project team maintain a common understanding of the project vision and scope.

OU2 Lead

Mr. Andrew Hopton will be the OU2 Lead. Mr. Hopton will be responsible for technical deliverables and tasks, including financials, schedule, and staffing. Mr. Hopton will communicate with the PM to provide updates and summaries of work performed and document all external communication and inform the PM.

Technical Director

Mr. Scott Saroff will be the Technical Director for this project. Mr. Saroff will provide strategic technical leadership for the project and be responsible for identification and management of subject matter. Mr. Saroff will be the primary senior reviewer for project deliverables and source of current information on industry practices and firm standard operating procedures. Mr. Saroff will work with a team of subject matter experts who will provide tactical or strategic support for specialized area(s) of expertise.

Health and Safety Manager

Mr. Bill Berlett will be the Health and Safety Manager for this project. Mr. Berlett will be responsible for writing and approving the HSP. He will be responsible for performing safety audits and assessments of field activities.

Site Safety Coordinator

The Site Safety Coordinators for this project will be Mr. Austin Harclerode and Ms. Jennifer Simms. Mr. Harclerode and Ms. Simms will ensure that the HSP is properly implemented and that all CH2M HILL and subcontractor site personnel are trained in the site-specific project health and safety requirements. Mr. Harclerode and Ms. Simms will have authority to stop work if unsafe conditions are observed.

Remedial Investigation Lead

Mr. Andrew Hopton will be the Remedial Investigation Lead. Mr. Hopton will be responsible for coordinating, scheduling, and controlling RI activities at the site to ensure that adequate data are collected. Mr. Hopton will also be responsible for coordinating the preparation of the RI report.

Feasibility Study Lead

Mr. Jeffrey Morrison will be the Feasibility Study Lead for this project. He will be responsible for coordinating, scheduling, and controlling the preparation of the FS.

SECTION 8

Project Schedule

A project schedule was developed for OU2. The schedule was developed based on the information provided in the OU2 AOC/SOW. The purpose of this section is to provide an understanding of the progression of tasks that will be performed to prepare the RI and FS documents for this project. The schedule is provided in Figure 8-1.

SECTION 9

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Table 3-1
Summary of Existing Sediment Sample Chemistry in OU2
Quanta Resources Site
Edgewater, New Jersey

General Depth Interval	Parameter	No. of Samples Collected	Min. Conc. Detected (mg/Kg)	Max. Conc. Detected (mg/Kg)	ER-L (mg/Kg)	ER-M (mg/Kg)	Location ID/depth for Max. Conc. Detected	Distance from Shore (feet)
0 - 1 ft	Total VOCs	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total PAH's	7	42.9	1140	4.02	44.79	Sed-1A/0 ft.	15-20
	PAHs							
	Naphthalene	16	0.061	270	0.16	2.1	Location 1/Dup.	15-20
	Acenaphthene	16	0.091	95	0.016	0.5	Location 1/Dup.	15-20
	Acenaphthylene	16	0.2	19	0.044	0.64	Sed-4A/0 ft.	15-20
	Anthracene	16	0.13	38	0.085	1.1	Location 1/Dup.	15-20
	Benzo(a)anthracene	16	0.36	69	0.261	1.6	Sed-4A/0 ft.	15-20
	Benzo(a)pyrene	16	0.46	61	0.43	1.6	Sed-4A/0 ft.	15-20
	Benzo(b)fluoranthene	16	0.54	73			Sed-4A/0 ft.	15-20
	Chrysene	16	0.46	62	0.384	2.8	Sed-4A/0 ft.	15-20
	Pyrene	16	0.64	140	0.665	2.6	Sed-1A/0 ft.	15-20
	Phenanthrene	16	0.41	190	0.24	1.5	Location 1/Dup.	15-20
	Fluorene	16	0.059	91	0.019	0.54	Location 1/Dup.	15-20

Table 3-1
Summary of Existing Sediment Sample Chemistry in OU2
Quanta Resources Site
Edgewater, New Jersey

General Depth Interval	Parameter	No. of Samples Collected	Min. Conc. Detected (mg/Kg)	Max. Conc. Detected (mg/Kg)	ER-L (mg/Kg)	ER-M (mg/Kg)	Location ID/depth for Max. Conc. Detected	Distance from Shore (feet)
1-24 ft	Fluoranthene	16	0.61	190	0.6	5.1	Location 1/Dup.	15-20
	PCBs							
	PCBs (total)	16	0.34	0.91	0.0227	0.18	Sed-3A/0 ft.	15-20
	Inorganics							
	Arsenic	16	13.6	19.3	8.2	70	Location 1/Dup.	15-20
	Chromium	16	69.5	88.8	81	370	Sed-1A/0 ft.	15-20
	Lead	16	97.9	130	46.7	218	Sed-4A/0 ft.	15-20
	Total VOCs	2	0.82	28.2			Sed-1.5C/4 ft.	100
	Total PAH's	13	51.5	21500	4.02	44.79	Sed-1B/3 ft.	70
	PAHs							
	Naphthalene	13	0.16	8,000	0.16	2.1	Sed-1A/4 ft.	15-20
	Acenaphthene	13	1.6	1500	0.016	0.5	Sed-1B/3 ft.	70
	Acenaphthylene	13	0.75	150	0.044	0.64	Sed-1B/3 ft.	70
	Anthracene	13	1.7	4600	0.085	1.1	VC-02/18 ft.	30-35
	Benzo(a)anthracene	13	3.3	640	0.261	1.6	Sed-1B/3 ft.	70
	Benzo(a)pyrene	13	2.4	430	0.43	1.6	Sed-1B/3 ft.	70
	Benzo(b)fluoranthene	13	3.3	500			Sed-1B/3 ft.	70

Table 3-1
Summary of Existing Sediment Sample Chemistry in OU2
Quanta Resources Site
Edgewater, New Jersey

General Depth Interval	Parameter	No. of Samples Collected	Min. Conc. Detected (mg/Kg)	Max. Conc. Detected (mg/Kg)	ER-L (mg/Kg)	ER-M (mg/Kg)	Location ID/depth for Max. Conc. Detected	Distance from Shore (feet)
	Chrysene	13	3.1	580	0.384	2.8	Sed-1B/3 ft.	70
	Pyrene	13	8.7	1600	0.665	2.6	Sed-1B/3 ft.	70
	Phenanthrene	13	5.8	3,700	0.24	1.5	Sed-1B/3 ft.	70
	Fluorene	13	1.5	1400	0.019	0.54	Sed-1B/3 ft.	70
	Fluoranthene	13	11	2200	0.6	5.1	Sed-1B/3 ft.	70
	PCBs							
	PCBs (total)	11	0.18	3.2	0.0227	0.18	Sed-1A/4 ft.	15-20
	Inorganics							
	Arsenic	11	17.4	100	8.2	70	CPT-9A/24 ft.	400
	Chromium	11	120	270	81	370	Sed-1A/4 ft.	15-20
	Lead	11	189	362	46.7	218	Sed-3A/2.7 ft.	15-20

Notes –

ER-L = Effects Range Low

ER-M = Effects Range – Medium

ER-L and ER-M are New Jersey Estuarine and Marine Sediment Screening Guidelines (NJ DEP 1998). Site Remediation Program. Source: GeoSyntec Consultants. *Removal Site Investigation Report Revision 1. Removal Site Investigation, Quanta Resources Site, Edgewater, New Jersey.* June 2000.

Table 3-2
Summary of Existing Sediment Sample Chemistry in OU2
Sites Adjacent to Quanta Resources Site
Edgewater, New Jersey

General Depth Interval	Parameter	No. of Samples Collected	Min. Conc. Detected (mg/Kg)	Max. Conc. Detected (mg/Kg)	ER-L (mg/Kg)	ER-M (mg/Kg)	Location	Location ID/depth for Max. Conc. Detected	Distance from Shore (feet)
0 - 1 ft	Total VOCs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total PAH's	28	4.7	437	4.02	44.79	Celotex	SC-04/0 ft.	50
	PAHs								
	Naphthalene	28	0.081	24	0.16	2.1	Celotex	SC-04/0 ft.	50
	Acenaphthene	28	0.076	32	0.016	0.5	Celotex	SC-04/0 ft.	50
	Acenaphthylene	28	0.3	3.9	0.044	0.64	Celotex	SC-04/0 ft.	50
	Anthracene	28	0.26	44	0.085	1.1	Celotex	SC-04/0 ft.	50
	Benzo(a)anthracene	28	0.61	18	0.261	1.6	Celotex	SC-04/0 ft.	50
	Benzo(a)pyrene	28	0.8	18	0.43	1.6	Unilever Research	SC-11/0 ft.	60
	Benzo(b)fluoranthene	28	1	24			Unilever Research	SC-11/0 ft.	60
	Chrysene	28	0.6	18	0.384	2.8	Celotex	SC-04/0 ft.	50
	Pyrene	28	1.3	54	0.665	2.6	Celotex	SC-04/0 ft.	50
	Phenanthrene	28	0.39	88	0.24	1.5	Celotex	SC-04/0 ft.	50
	Fluorene	28	0.092	36	0.019	0.54	Celotex	SC-04/0 ft.	50
	Fluoranthene	28	0.017	70	0.6	5.1	Celotex	SC-04/0 ft.	50
	PCBs								
	PCBs (total)	28	0.34	3.5	0.0227	0.18	Celotex	SC-03/0 ft.	50
	Inorganics								
	Arsenic	28	6.7	2,150	8.2	70	Celotex	SC-04/0 ft.	50
	Chromium	28	43.2	160	81	370	Celotex	SC-03/0 ft.	50
	Lead	28	62.9	1540	46.7	218	Celotex	SC-01/0 ft.	200
1-4 ft	Total VOCs	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
	Total PAH's	20	7	17400	4.02	44.79	Celotex	SC-04/4 ft.	50
	PAHs								

Table 3-2
Summary of Existing Sediment Sample Chemistry in OU2
Sites Adjacent to Quanta Resources Site
Edgewater, New Jersey

General Depth Interval	Parameter	No. of Samples Collected	Min. Conc. Detected (mg/Kg)	Max. Conc. Detected (mg/Kg)	ER-L (mg/Kg)	ER-M (mg/Kg)	Location	Location ID/depth for Max. Conc. Detected	Distance from Shore (feet)
	Naphthalene	20	0.055	3,700	0.16	2.1	Celotex	SC-04/4 ft.	50
	Acenaphthene	20	0.067	1200	0.016	0.5	Celotex	SC-04/4 ft.	50
	Acenaphthylene	20	0.22	76	0.044	0.64	Celotex	SC-04/4 ft.	50
	Anthracene	20	0.24	3600	0.085	1.1	Celotex	SC-04/4 ft.	50
	Benzo(a)anthracene	20	0.56	280	0.261	1.6	Celotex	SC-04/4 ft.	50
	Benzo(a)pyrene	20	0.64	190	0.43	1.6	Celotex	SC-02/3 ft.	100
	Benzo(b)fluoranthene	20	0.72	220			Celotex	SC-02/3 ft.	100
	Chrysene	20	0.53	270	0.384	2.8	Celotex	SC-04/4 ft.	50
	Pyrene	20	1.1	960	0.665	2.6	Celotex	SC-04/4 ft.	50
	Phenanthrene	20	0.39	3,600	0.24	1.5	Celotex	SC-04/4 ft.	50
	Fluorene	20	0.084	1800	0.019	0.54	Celotex	SC-04/4 ft.	50
	Fluoranthene	20	1.1	1500	0.6	5.1	Celotex	SC-04/4 ft.	50
	PCBs								
	PCBs (total)	20	ND	6.5	0.0227	0.18	Celotex	SC-09/4 ft.	200
	Inorganics								
	Arsenic	20	15.7	1,860	8.2	70	Celotex	SC-04/4 ft.	50
	Chromium	20	61.1	94.8	81	370	Celotex	SC-03/4 ft.	50
	Lead	20	128	780	46.7	218	Celotex	SC-01/4 ft.	200

Notes –

ER-L = Effects Range Low

ER-M = Effects Range – Medium

ER-L and ER-M are New Jersey Estuarine and Marine Sediment Screening Guidelines (NJ DEP 1998). Site Remediation Program. Source: GeoSyntec Consultants. *Removal Site Investigation Report Revision 1. Removal Site Investigation, Quanta Resources Site, Edgewater, New Jersey.* June 2000.

Table 3-3
Summary of Existing Sediment Chemistry in OU2
Collected in May 2000 by EPA for the Ecological Risk Assessment
Quanta Resources Site
Edgewater, New Jersey

	ER-L	ER-M	Location 1	Location 1 Dup	Location 2	Location 2 Sub	Location 3	Location 4	Location 4 Sub	Location 5	Location 6
Volatile Organic Compounds (mg/kg)											
p-Isopropyltoluene	NE	NE	660 U	660 U	2.6 U	2.5 U	26 U	26 U	2.3 U	2.5 U	2.8 U
Naphthalene	NE	NE	30000	31000	6.3 J	3.7 J	1800	2700	9.1 U	10 U	11
1,3-Dichlorobenzene	NE	NE	660 U	660 U	74	2.5 U	26 U	26 U	2.3 U	2.5 U	2.8 U
Acetone	NE	NE	5300 U	2400 J	47	39	180 J	210 U	27	36	29
2-Butanone	NE	NE	2600 U	2600 U	8.3 J	10	97 J	110	7.9 J	9.1 J	6.8 J
Semivolatile Organic Compounds (µg/kg)											
4-Methylphenol	NE	NE	400 J	730 J	2,600 U	2,400 U	2,500 U	2,600 U	2,300 U	2,300 U	2,700 U
Naphthalene	160	2100	110,000	270,000	570 J	190 J	1,100 J	1,700 J	2,300 U	130 J	2,700 U
2-Methylnaphthalene	70	670	31,000	160,000	2,600 U	2,400 U	370 J	690 J	2,300 U	2,300 U	2,700 U
Acenaphthylene	44	640	4,600	12,000	1,000 J	370 J	1,500 J	570 J	210 J	2,300 U	2,700 U
Acenaphthene	16	500	26,000	95,000	1,800 J	840 J	2,600	1,500 J	150 J	110 J	2,700 U
Dibenzofuran	NE	NE	20,000	42,000	760 J	520 J	740 J	730 J	2,300 U	2,300 U	2,700 U
Fluorene	19	540	26,000	91,000	1,500 J	660 J	1,400 J	1,300 J	2,300 U	2,300 U	2,700 U
Diethylphthalate	NE	NE	300 J	1400 J	450 J	460 J	550 J	580 J	390 J	640 J	320 J
Phenanthrene	240	1500	74,000	190,000	7,600	2,200 J	7100	5,300 J	740 J	410 J	700 J
Anthracene	85	1100	16,000	38,000	2,100 J	580 J	2,500	1,300 J	260 J	130 J	190 J
Carbazole	NE	NE	4,400	12,000	290 J	2,400 U	330 J	290 J	2,300 U	2,300 U	2,700 U
Di-n-butylphthalate	NE	NE	2,100 J	6,900	6,000	5900	4,700	7,600	4,600	5,300	1,200 J
Fluoranthene	600	5100	78,000	190,000	19,000	7200	28,000	12,000	3,700	1,600 J	1,900 J
Pyrene	665	2600	27,000	100,000	10,000	4,600	15,000	6,400	2,100 J	1,100 J	970 J
Benzo(a)anthracene	261	1600	21,000	64,000	7,900	2900	12,000	49,000	1,400 J	630 J	790 J
Chrysene	384	2800	16,000	42,000	6,300	2,500	9,600	3,700	1,100 J	500 J	600 J
bis(2-Ethylhexyl)ph	NE	NE	1,200 J	2,800	1,000 J	550 J	820 J	850 J	680 J	850 J	800 J
Benzo(b)fluoranthene	NE	NE	17,000	52,000	7,900	4,100	12,000	5,500	1,700 J	780 J	780 J
Benzo(k)fluoranthene	240	1340000	9,000	22,000	3,800	920 J	4,700	1,800 J	470 J	2,300 U	2,700 U
Benzo(a)pyrene	430	1600	16,000	49,000	7,700	3000	10,000	4,500	1,400 J	700 J	710 J
Indeno(1,2,3-cd)py	200	320000	9200	26000	4500	2,100 J	6600	2400 J	920 J	2,300 U	2,700 U
Dibenzo(a,h)anthracene	63	260	2,700	7,000	2,600 U	680 J	2000 J	2,600 U	2,300 U	2,300 U	2,700 U
Benzo(g,h,i)perylene	170	320000	11,000	28,000	5,200	2,400 J	7,600	2,600	1,000 J	2,300 U	2,700 U
Pesticide/Polychlorinated Biphenyls (µg/kg)											
Endosulfan II	NE	NE	8.4 U	9.7	8.4 U	7.9 U	8.1 U	8.3 U	7.7 U	7.7 U	8.9 U
Endosulfan Sulfate	NE	NE	24.0	31	4.6 J	14	7.1 J	8.3 U	3.0 J	7.7 U	8.9 U
4,4'-DDT	1.6	46	28	24	8.4 U	5.8 J	8.1 U	4.3 J	7.7 U	7.7 U	8.9 U
Gamma-Chlordane	NE	NE	79	72	12	31	33	34	26	24	4.6 U
Aroclor 1016	7	53000	250 U	270 U	260 U	240 U	250 U	250 U	230 U	230 U	270 U
Aroclor 1221	NE	NE	510 U	540 U	510 U	480 U	490 U	500 U	470 U	470 U	540 U
Aroclor 1232	NE	NE	250 U	270 U	260 U	240 U	250 U	250 U	230 U	230 U	270 U
Aroclor 1242	NE	NE	250 U	270 U	260 U	240 U	250 U	250 U	230 U	230 U	270 U
Aroclor 1248	30	150000	250 U	270 U	260 U	240 U	250 U	250 U	230 U	230 U	270 U
Aroclor 1254	60	34000	250 U	270 U	260 U	240 U	250 U	250 U	230 U	230 U	270 U
Aroclor 1260	5	24000	250 U	270 U	260 U	240 U	250 U	250 U	230 U	230 U	270 U

Table 3-3
Summary of Existing Sediment Chemistry in OU2
Collected in May 2000 by EPA for the Ecological Risk Assessment
Quanta Resources Site
Edgewater, New Jersey

	ER-L	ER-M	Location 1	Location 1 Dup	Location 2	Location 2 Sub	Location 3	Location 4	Location 4 Sub	Location 5	Location 6
Inorganics (mg/kg)											
Aluminum	NE	NE	16,700	16,000	15,000	16,600	14,700	15,500	16,000	15,000	17,000
Antimony	NE	NE	2.3	1.8	1.2 U	1.1 U	0.92	1.1 U	0.87 U	1.2 U	1.6
Arsenic	8.2	70	17.2	19.3	13.3	18.2	15.6	14.1	16.9	12.8	13.9
Barium	NE	NE	70.8	71.4	68.9	77	72.4	70.5	71	65.3	72.9
Beryllium	NE	NE	1.0	1.1	0.91	0.98	0.84	0.94	0.93	0.92	1.0
Cadmium	1.2	9.6	0.45	0.82	0.57	0.86	0.63	0.38	0.64	0.46	0.36
Calcium	NE	NE	4210	4450	4020	4,040	4,390	4,160	3940	3,790	4,320
Chromium	81	370	80.3	84.7	69.9	83.6	68.9	71.8	80.3	68.1	74.6
Cobalt	NE	NE	12.1	12	10.6	11.8	10.6	11.2	11.3	10.8	12.4
Copper	34	270	101	115	90.6	109	94.1	91.5	103	83.3	89.8
Iron	NE	NE	35,300	36,200	30,900	33,300	30,900	31,700	32,200	30,000	33,900
Lead	47	218	113	116	95.6	118	103	98.2	111	90.8	98.1
Magnesium	NE	NE	8,110	8270	7400	8,020	7,660	7,770	7,720	7,190	8,120
Manganese	NE	NE	746	705	538	462	502	575	505	542	672
Mercury	0.15	0.71	1.7	1.8	1.5	1.7	1.9	1.4	1.8	1.5	1.4
Nickel	21	52	33.7	34.4	32.9	37.8	35.9	34	35.9	30.9	33.7
Potassium	NE	NE	3450	3370	3060	3,370	2,860	3,190	3150	3,040	3,340
Selenium	NE	NE	1.5 U	1.6 U	1.5 U	1.4 U	1.1 U	1.4 U	1.1 U	1.5 U	1.4 U
Silver	1	3.7	4.0	4.7	3.3	4.0	3.2	3.4	3.9	3.2	3.3
Sodium	NE	NE	6020	6190	5310	6000	5160	6040	5500	4520	5160
Thallium	NE	NE	2.3 U	2.5 U	2.3 U	2.1 U	1.7 U	2.1 U	1.6 U	2.3 U	2.2 U
Vanadium	NE	NE	39.9	40.2	34.70	40	34.6	36.2	38.1	34.2	38.6
Zinc	150	410	214	237	198	240	213	201	219	185	202
Other Parameters (mg/kg)											
Hydrocarbons (mg/kg)	NE	NE	2400 J	3000 J	880	1800 J	2200 J	800	860	670 J	570 J

Notes -

ER-L = Effects Range-Low

ER-M = Effects Range- Medium

ER-L and ER-M are New Jersey Estuarine and Marine Sediment Screening Guidelines (NJ DEP 1998). Site Remediation Program:

mg/kg = milligrams per kilogram

µg/kg = micrograms per kilogram

U = Not detected at indicated value

J = denotes estimated value

Table 3-4
Summary of Benthic Macroinvertebrate Survey Results in OU2
Collected in May 2000 by EPA for the Ecological Risk Assessment
Quanta Resources Site
Edgewater, New Jersey

Phylum	Class	Sub-class	Order	Family	Genus species	Locations					
						1	2	3	4	5	6
Nematoda						2	1	1	0	0	0
Nemertinea						0	0	0	3	13	2
Annelida	Oligochaeta					152	1162	786	1307	249	126
	Polychaeta			Ampharetidae	<i>Asabellides oculata</i>	9	0	4	4	0	1
				Capitellidae		0	18	0	6	2	7
				Nereidae	<i>Neanthes succinea</i>	0	3	1	1	13	6
				Orbinidae	<i>Leitoscoloplos sp.</i>	0	2	0	100	1	0
				Phyllodocidae	<i>Eteone heteropoda</i>	1	14	10.0	23	6	2
				Spionidae	<i>Polydora ligni</i>	1	0	0	0	0	0
					<i>Scolecopides viridis</i>	0	1	0	0	4	0
					<i>Sterblospio benedicti</i>	2	52	49	34	4	1
Arthropoda		Copepoda				7	2	3	3	4	2
			Amphipoda	Gammaridea		0	0	0	1	1	0
			Isopoda		<i>Cyathura polita</i>	0	0	0	0	4	4
Molluska	Bivalvia			Tellinidae	<i>Macoma balthica</i>	1	0	2	0	4	3
					<i>Telina agilis</i>	1	1	0	4	1	1
Total Taxa not including Nematodes and Copepods						7	8.000	6	10	12	10
Total Individuals not including Nematodes and Copepods						167	1253.000	852	1385	302	153.00
Shannon Diversity not including Nematodes and Copepods						0.419	0.349	0.338	0.304	0.827	0.812
Evenness not including Nematodes and Copepods						0.060	0.044	0.056	0.030	0.069	0.081

Table 3-5
Summary of Sediment Toxicity Results in OU2
Collected in May 2000 by EPA for the Ecological Risk Assessment
Quanta Resources Site
Edgewater, New Jersey

Treatment	<i>L. plumulosus</i>			<i>M. beryllina</i>	
	% Survival	Mean Growth (weight) mg	% Reburial	% Survival	Mean Growth (weight) mg
Control (water)	NA	NA	NA	98	1.92
Control (sediment)	99	0.900	100	98	1.84
Location 1 (1% site sediment)	100	0.838*	100	NA	NA
Location 1 (1% site sediment)	83*	0.672*	100	NA	NA
Location 1 (1% site sediment)	2*	0.475*	NI	NA	NA
Location 1 (1% site sediment)	1*	0.400*	NI	0*	NM
Location 2 surface	98	0.724*	99	100	1.99
Location 2 sub-surface	94	0.507*	66*	100	1.80
Location 3	69*	0.550*	28*	92	1.88
Location 4 surface	96	0.679*	100	90	1.84
Location 4 sub-surface	98	0.545*	100	100	1.60*
Location 5	99	0.635*	100	94	1.75
Location 6	98	0.692*	99	100	1.72

mg - milligrams

* Significantly different in comparison to laboratory control results.

NA - not applicable

NM - organisms not measured (0% survival)

NI - Not included in statistical analysis because of significant mortality

Table 5-1
Proposed Sediment/Soil Core Locations and Sampling in OU2
Quanta Resources Site
Edgewater, New Jersey

Sample Description	Sample Depth	# of Samples	QA/QC Samples	Parameter	Analytical Method
<u>Sediment Surface Samples</u> (Area A and Area B)	0 - 0.5 ft	77 grid, 10 upstream, 10 downstream	MS/MSD (4 pair) Duplicate (5) Trip Blank (per SDG)	<u>Chemical</u> VOCs SVOCs PCBs PCB congeners for 14 locations Metals (arsenic, lead, chromium, copper, mercury, nickel, silver, zinc) <u>Physical</u> Grain Size Distribution TOC	SW-846 8260B SW-846 8270C SW-846 8082 EPA 1668 SW-846 SW6010B/7000 Series ASTM D-422 SW-846 9060
<u>Sediment Subsurface Samples</u> (Area A and Area B)	0.5 - 1.0 ft 1 - 2 ft 2 - 4 ft 4 - 6 ft 6 - 8 ft	14 out of 77 locations within grid	MS/MSD (4 pair) Duplicate (4) Trip Blank (per SDG)	<u>Chemical</u> VOCs SVOCs PCBs PCB congeners for 14 locations for top 2	SW-846 8260B SW-846 8270C SW-846 8082 EPA 1668

Table 5-1
Proposed Sediment/Soil Core Locations and Sampling in OU2
Quanta Resources Site
Edgewater, New Jersey

Sample Description	Sample Depth	# of Samples	QA/QC Samples	Parameter	Analytical Method
	8 - 10 ft 12 - 14 ft 16 - 18 ft 22 - 24 ft 28 - 30 ft			depths Metals (arsenic, lead, chromium, copper, mercury, nickel, silver, zinc) <u>Physical</u> Grain Size Distribution TOC	SW-846 SW6010B/7000 Series ASTM D-422 SW-846 9060
Supplemental Sediment Surface Samples in area north of Former Gypsum Landfill Area	0 - 0.5 ft	5	MS/MSD (1 pair) Duplicate (1) Trip Blank (per SDG)	<u>Chemical</u> VOCs SVOCs PCBs Metals (arsenic, lead, chromium, copper, mercury, nickel, silver, zinc) <u>Physical</u> Grain Size Distribution	SW-846 8260B SW-846 8270C SW-846 8082 SW-846 SW6010B/7000 Series ASTM D-422

Table 5-1
Proposed Sediment/Soil Core Locations and Sampling in OU2
Quanta Resources Site
Edgewater, New Jersey

Sample Description	Sample Depth	# of Samples	QA/QC Samples	Parameter	Analytical Method
				TOC	SW-846 9060
Supplemental Sediment Subsurface Samples in area north of Former Gypsum Landfill Area (Chemical)	0.5 - 1.0 ft	1 of the 5 surface locations, one sample will be collected at each interval	Trip Blank (per SDG)	<u>Chemical</u>	
	1 - 2 ft			SVOCs	SW-846 8270C
	2 - 4 ft			PCBs	SW-846 8082
				Metals (arsenic, lead, chromium, copper, mercury, nickel, silver, zinc)	SW-846 SW6010B/7000 Series
				<u>Physical</u>	
				Grain Size Distribution	ASTM D-422
				TOC	SW-846 9060
<u>Geochronology of Sediment Samples</u>	0 - 15 ft	Three cores	Trip Blank (per SDG)	Cesium-137	EML HASL 300

Table 7-1
Key Project Contacts
Quanta Resources Site
Edgewater, New Jersey

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Table 7-1
Key Project Contacts
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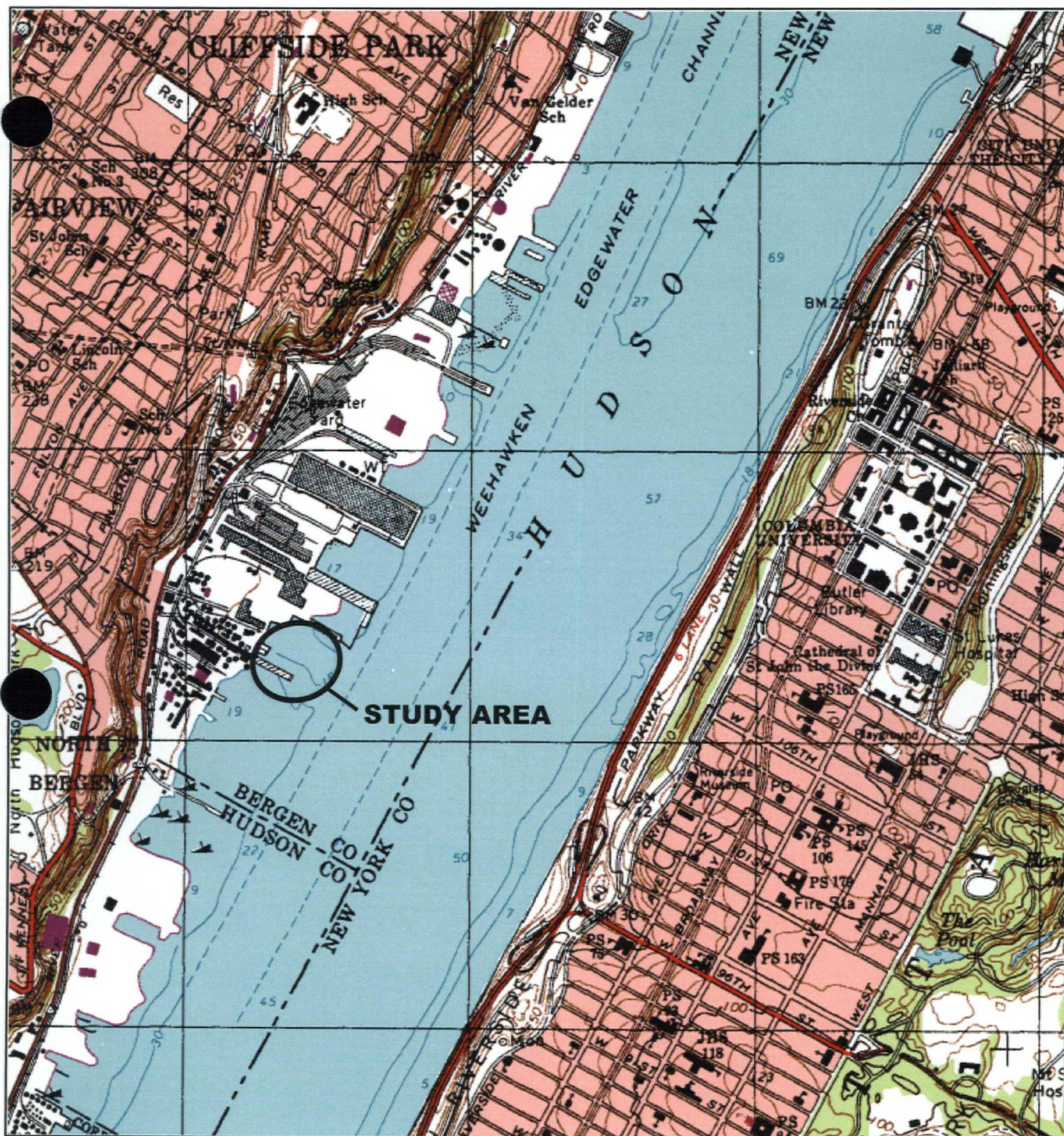
Fax: (973) 868-3110

Email: jmorriso@ch2m.com

Figures

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- Figure 1-2 Site Plan
- Figure 2-1 Previous Environmental Sampling Locations
- Figure 3-1 Summary of Sediment Chemistry Results OU2
- Figure 5-1 Proposed Environmental Sampling Locations OU2
- Figure 5-2 Up and Down River Sediment Sample Locations OU2
- Figure 8-1 Project Schedule



Map Source:
USGS Central Park (NY, NJ)
7.5 Min Quad



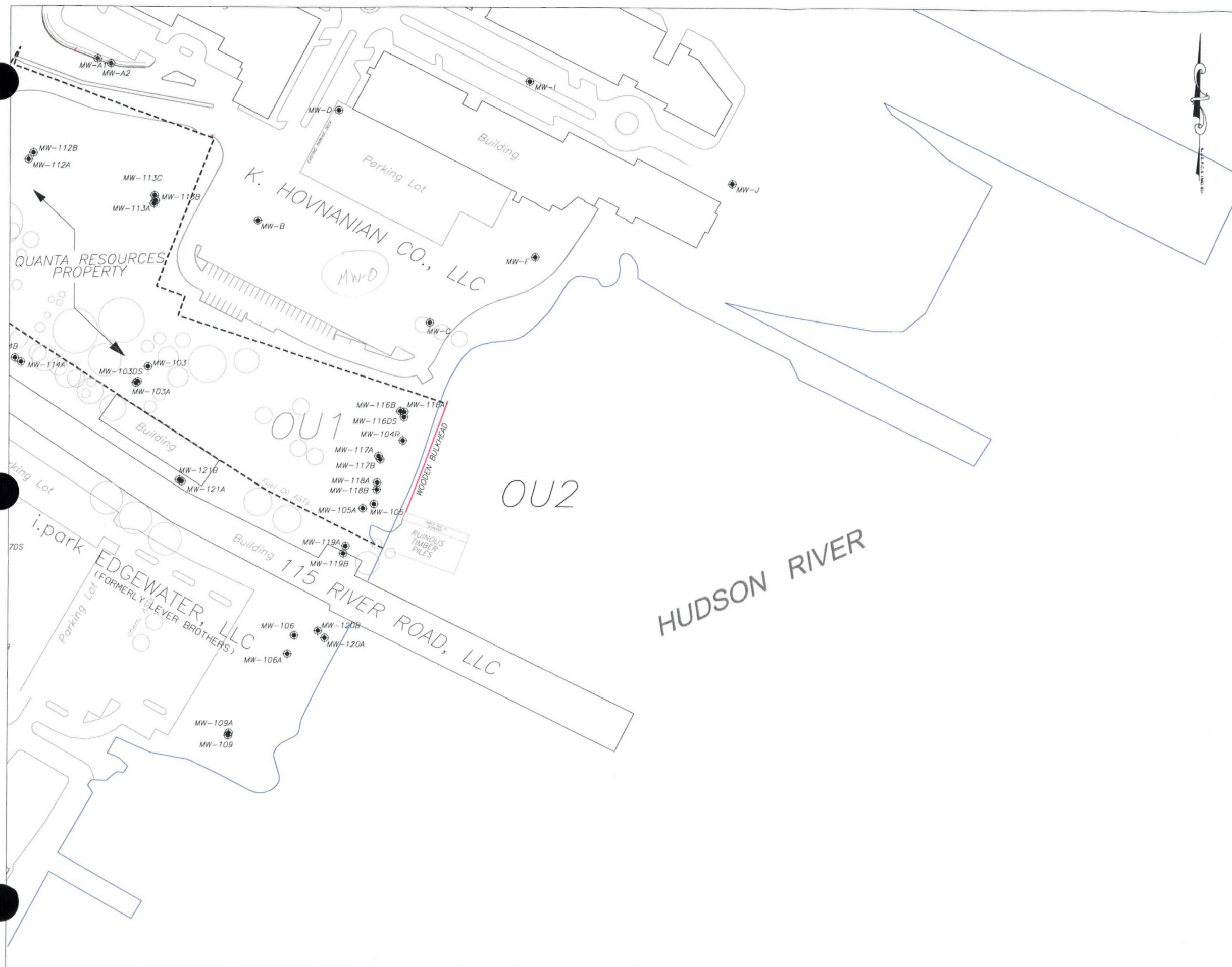
Figure 1.1
Site Location Map

Quanta Resources Site
Edgewater, New Jersey

August 18, 2006

Fig1.1.mxd





LEGEND

- MW-103
● EXISTING MONITORING WELL (OU1)
- FORMER ABOVE GROUND STORAGE TANK
- CURRENT QUANTA RESOURCES PROPERTY BOUNDARY

NOTES:

1. Survey of Quanta Resources property and select features at adjacent properties performed by Vargo Associates, Franklinville, New Jersey in December 2005 and updated as recently as April 2006.

DRAFT

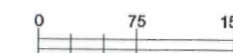
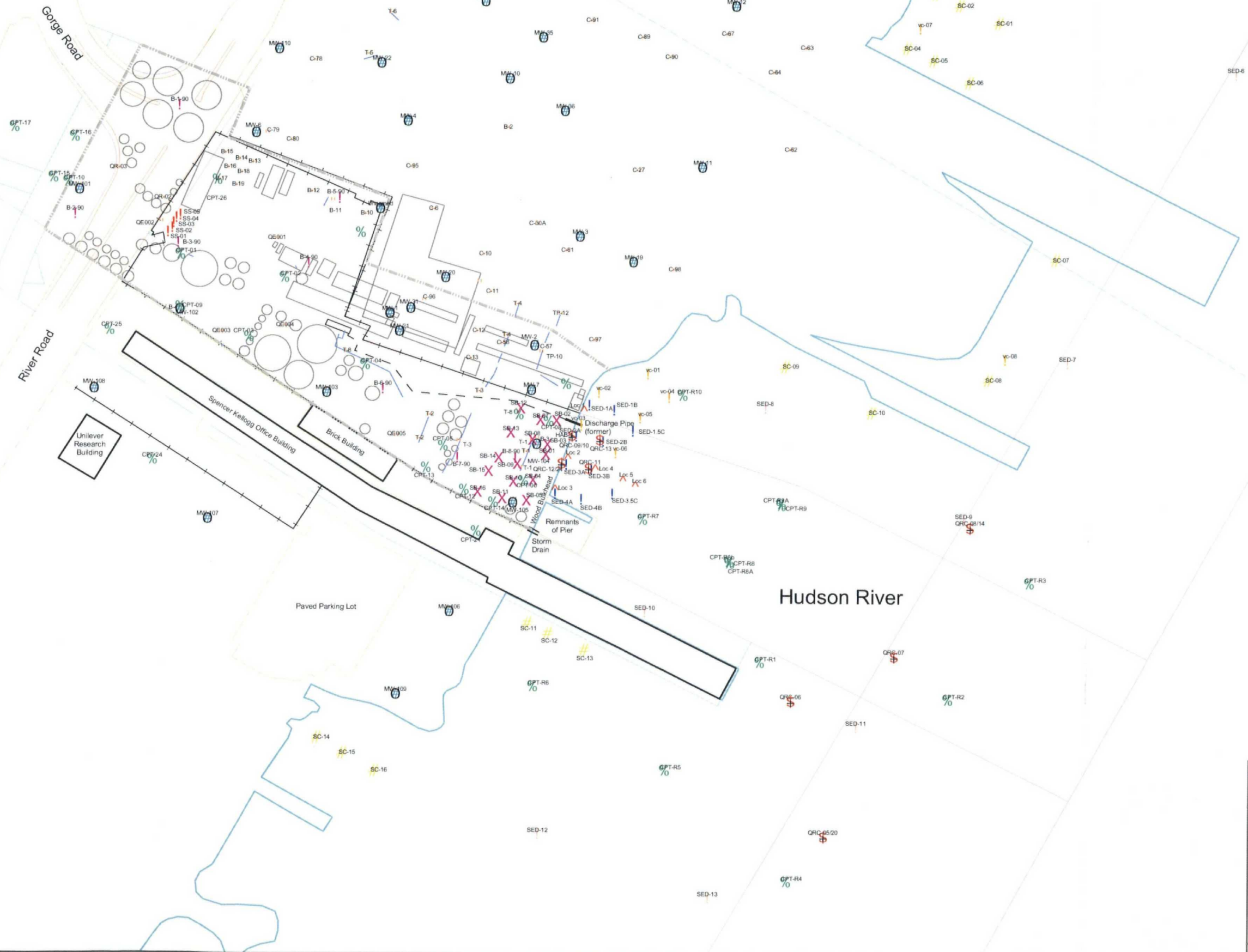


FIGURE 1.2
SITE PLAN (OU2)

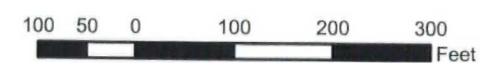
Quanta Resources Site
Edgewater, New Jersey

August 17, 2006

FIGURE 1.2



- Legend**
- Surface Soil Sample
 - Soil Sample
 - Predesign Soil Boring
 - CPT/ROST Location
 - Sediment Sample
 - Sediment Sample
 - Surface Sediment Sample
 - Sediment Core
 - Existing Monitoring wells
 - 1990 Soil Boring
 - Sediment Sample
 - Sediment Sample
 - Former Metal Plant
 - Test Pit Trench
 - Former Quanta Property Boundary
 - Storm Drain
 - China-link Fence
 - Line From Oil/Water Separator
 - Former Structures
 - Existing Buildings
 - Shoreline
 - Former AST



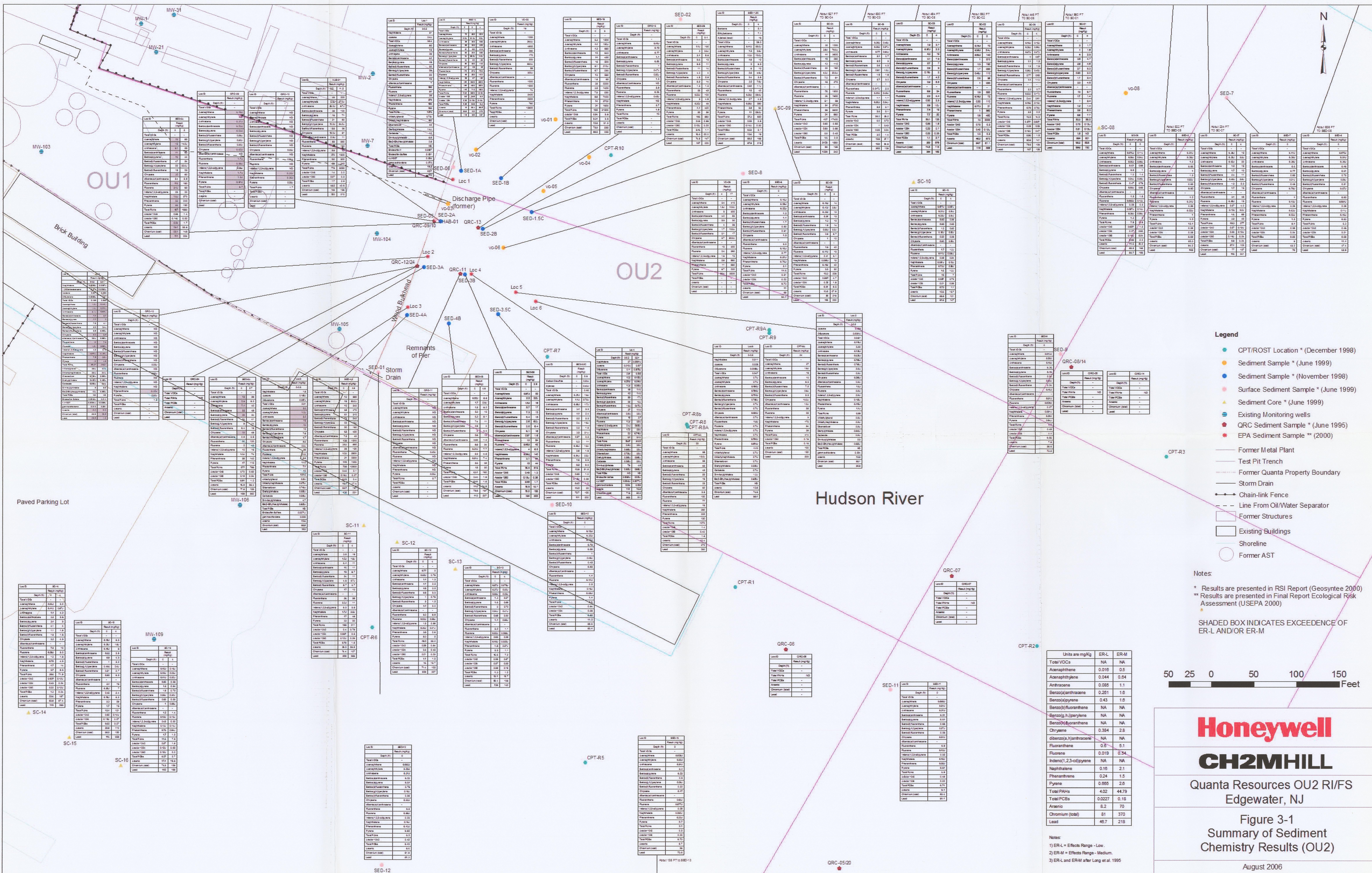
Honeywell

CH2MHILL

Quanta Resources OU2 RI/FS
Edgewater, NJ

Figure 2-1
Previous Environmental
Sampling Locations

August 2006

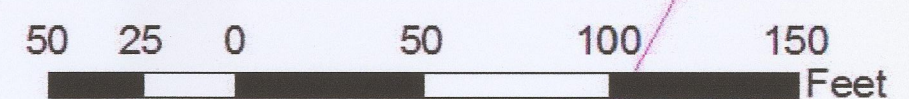


- Legend**
- CPT/RST Location * (December 1998)
 - Sediment Sample * (June 1999)
 - Sediment Sample * (November 1998)
 - Surface Sediment Sample * (June 1999)
 - Sediment Core * (June 1999)
 - Existing Monitoring wells
 - QRC Sediment Sample * (June 1995)
 - EPA Sediment Sample ** (2000)
 - Former Metal Plant
 - Test Pit Trench
 - Former Quanta Property Boundary
 - Storm Drain
 - Chain-Link Fence
 - Line From Oil/Water Separator
 - Former Structures
 - Existing Buildings
 - Shoreline
 - Former AST

Notes

* Results are presented in RSI Report (Geosyntec 2000)
** Results are presented in Final Report Ecological Risk Assessment (USEPA 2000)

SHADED BOX INDICATES EXCEEDENCE OF ER-L AND/OR ER-M



Honeywell
CH2MHILL
Quanta Resources OU2 RI/FS
Edgewater, NJ

Figure 3-1
Summary of Sediment
Chemistry Results (OU2)

August 2006

Units are mg/kg			
	ER-L	ER-M	
Total VOCs	NA	NA	
Aroclor 1248	0.015	0.5	
Aroclor 1254	0.044	0.54	
Anthracene	0.085	1.1	
Benzo(a)anthracene	0.291	1.8	
Benzo(b)fluoranthene	0.43	1.8	
Benzo(g,h,i)perylene	NA	NA	
Benzo(k)fluoranthene	NA	NA	
Chrysene	0.384	2.8	
dibenz(a,h)anthracene	NA	NA	
Fluoranthene	0.6	5.1	
Fluorene	0.019	0.54	
Indeno(1,2,3-cd)pyrene	NA	NA	
Naphthalene	0.15	2.1	
Phenanthrene	0.24	1.5	
Pyrene	0.085	2.8	
Total PAHs	4.02	44.79	
Total PCBs	0.0227	0.18	
Arsenic	8.2	70	
Chromium (total)	81	370	
Lead	48.7	218	

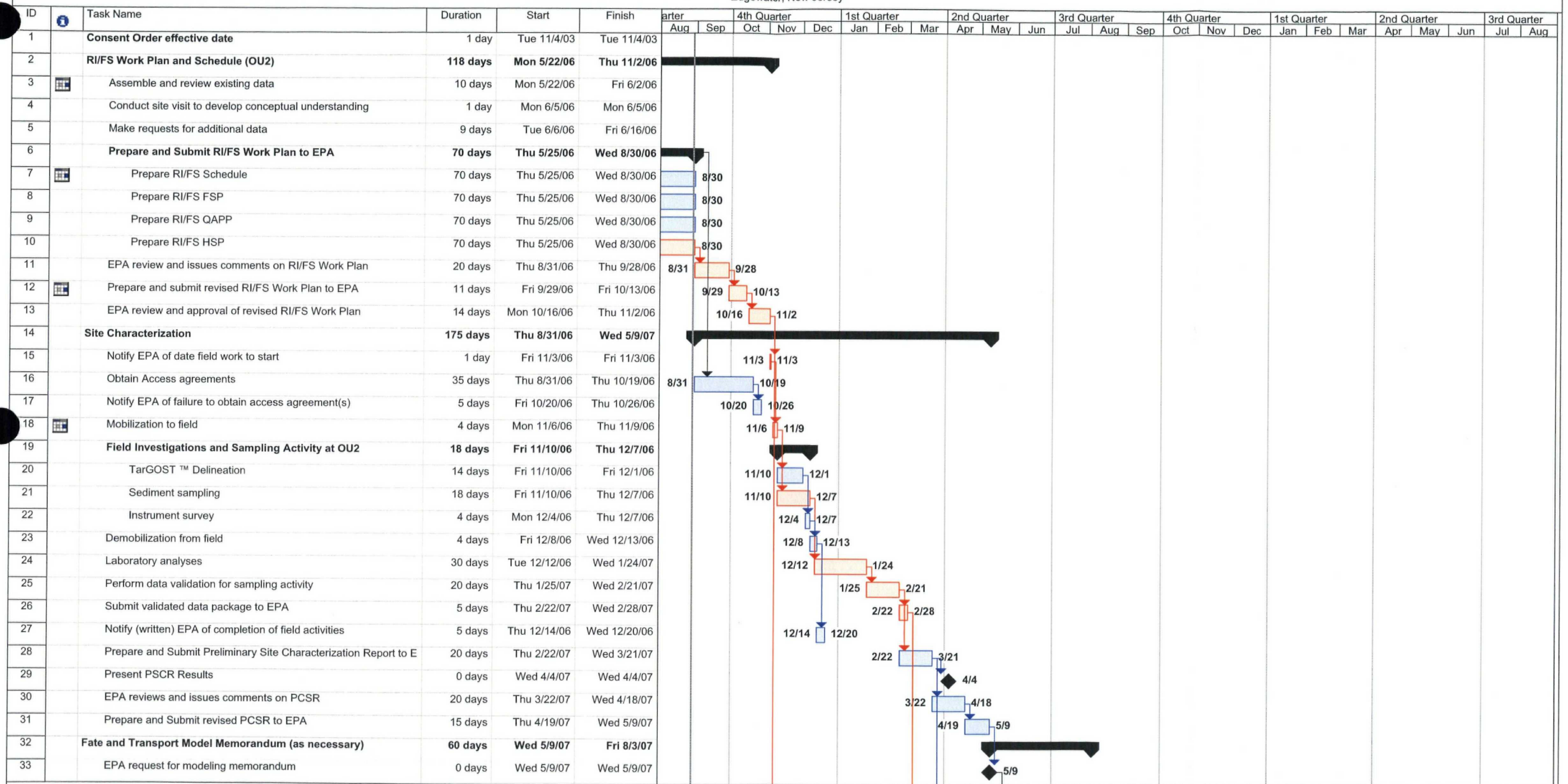
Notes:
1) ER-L = Effects Range - Low
2) ER-M = Effects Range - Medium
3) ER-L and ER-M are from Long et al. 1995





Figure 8-1.
Project Schedule OU2
Quanta Resources Site RI/FS Work Plan
Edgewater, New Jersey

Tue 8/29/06 12:48 PM



Project: Quanta
Date: Tue 8/29/06

Task

Critical Task

Progress

Task

Critical Task

Progress

Milestone

Summary

Rolled Up Task

Milestone

Summary

Rolled Up Task

Rolled Up Critical Task

Rolled Up Milestone

Rolled Up Progress

Rolled Up Critical Task

Rolled Up Milestone

Rolled Up Progress

Split

External Tasks

Project Summary

Split

External Tasks

Project Summary

Group By Summary

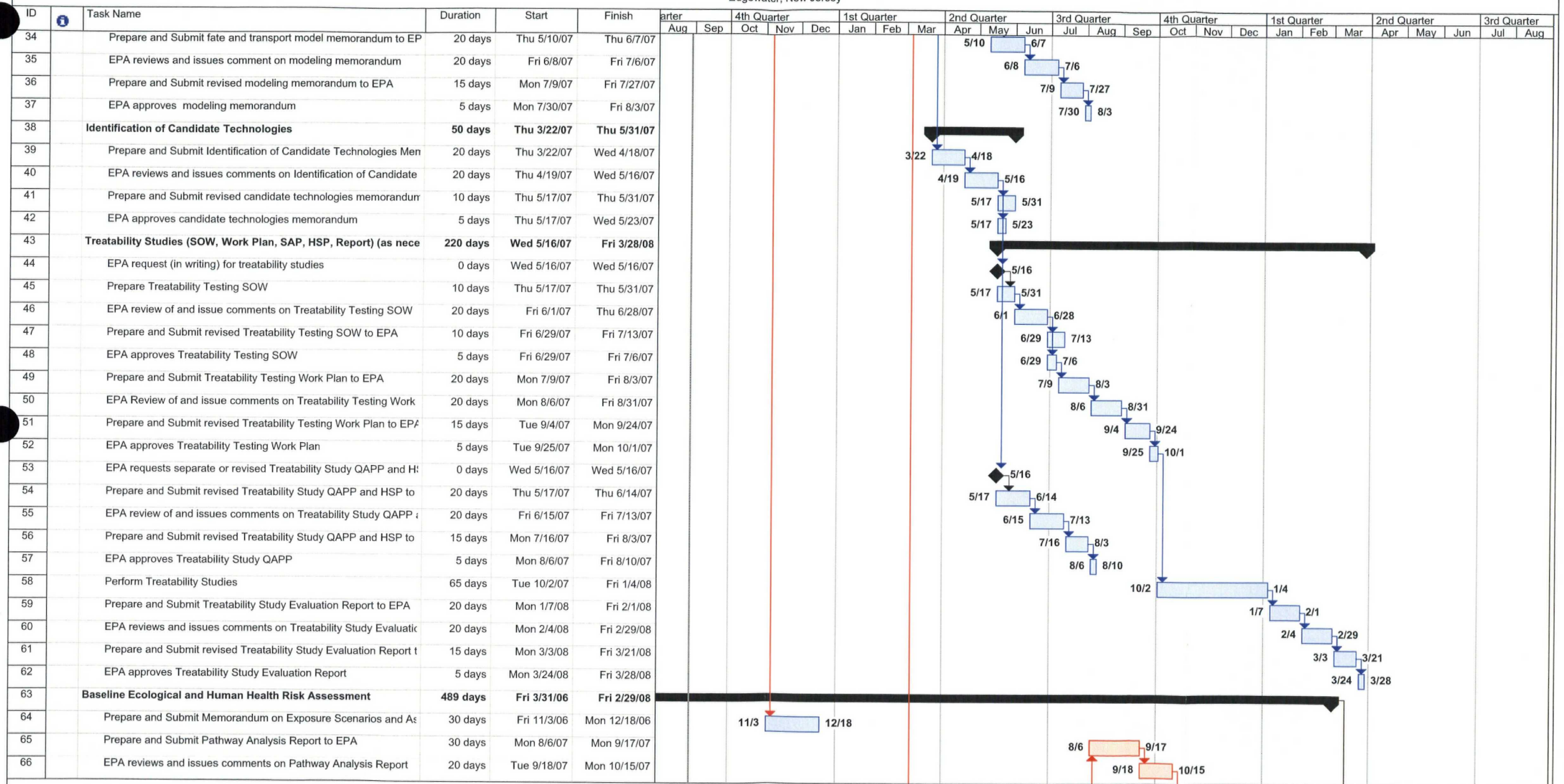
Deadline

Group By Summary

Deadline

Figure 8-1.
Project Schedule OU2
Quanta Resources Site RI/FS Work Plan
Edgewater, New Jersey

Tue 8/29/06 12:48 PM



Project: Quanta
Date: Tue 8/29/06

Task

Critical Task

Progress

Milestone

Summary

Rolled Up Task

Rolled Up Critical Task

Rolled Up Milestone

Rolled Up Progress

Split

External Tasks

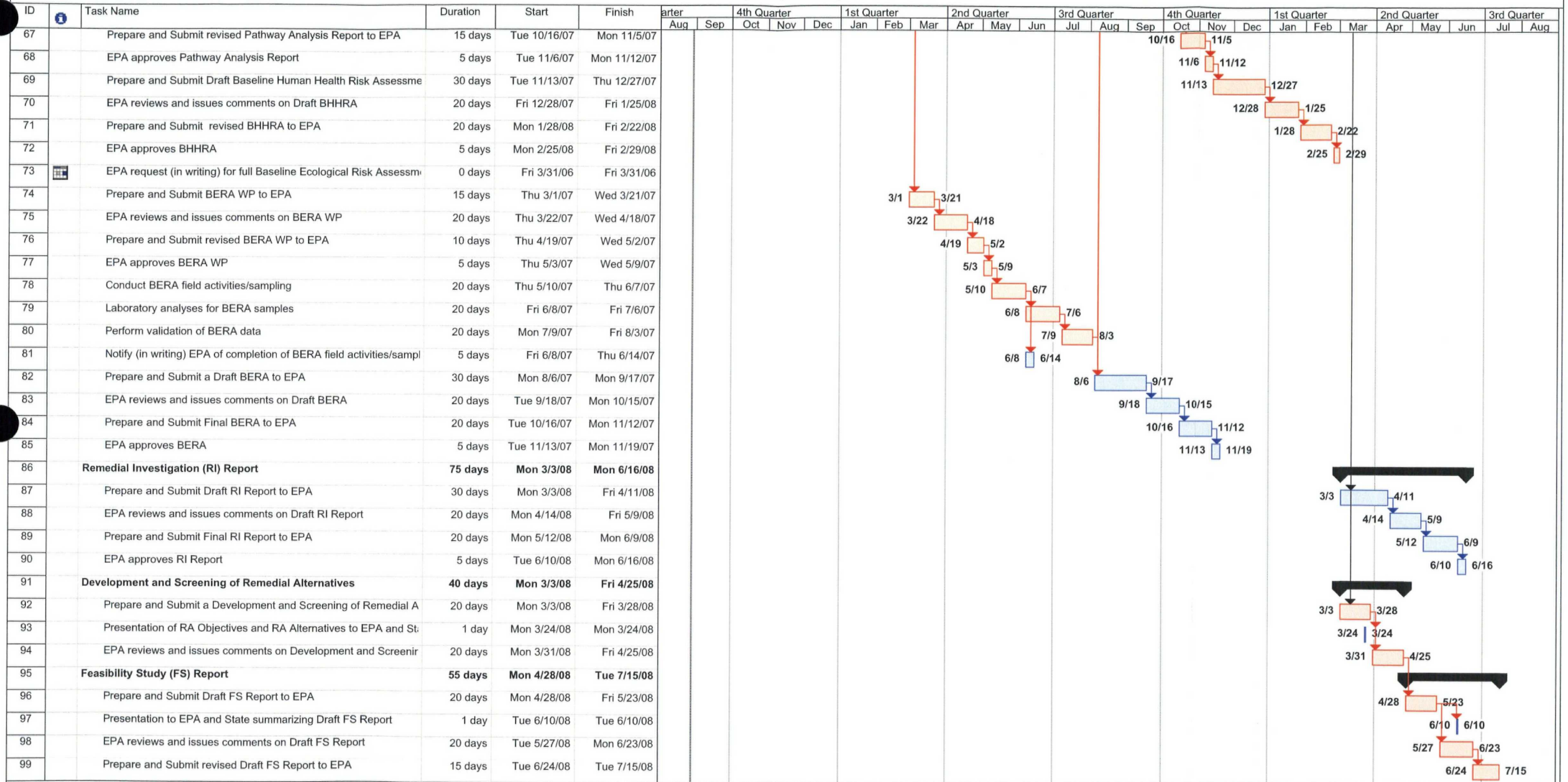
Project Summary

Group By Summary

Deadline

Figure 8-1.
Project Schedule OU2
Quanta Resources Site RI/FS Work Plan
Edgewater, New Jersey

Tue 8/29/06 12:48 PM



Project: Quanta
Date: Tue 8/29/06

Task

Critical Task

Progress

Milestone

Summary

Rolled Up Task

Rolled Up Critical Task

Rolled Up Milestone

Rolled Up Progress

Split

External Tasks

Project Summary

Group By Summary

Deadline

Appendix A Field Sampling Plan, Operable Unit 2 Quanta Resources Site Edgewater, New Jersey

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Reviewed and Approved By:

Project Manager:



Date: 8/10/2006

QA Manager:



Date: 8/10/2006

Distribution List

In accordance with the Administrative Order on Consent (AOC) for Operational Unit 2 (OU2), all work plans, reports, notices, and other documents will be submitted via certified mail, return receipt requested, or overnight mail to the following addressees:

NUMBER OF COPIES	TO
7 (Including 1 unbound copy)	ATTN: Quanta Resources Site Remedial Project Manager New Jersey Remediation Branch Emergency and Remedial Response Division U.S. Environmental Protection Agency, Region II 290 Broadway, 19th Floor New York, New York 10007-1866
1	ATTN: Quanta Resources Site Attorney New Jersey Superfund Branch Office of Regional Counsel U.S. Environmental Protection Agency, Region II 290 Broadway, 17th Floor New York, New York 10007-1866
4	ATTN: Quanta Site Manager Bureau of Federal Case Management New Jersey Department of Environmental Protection 401 East State Street P.O. Box 028 Trenton, New Jersey 08625-0028
4	Tim Metcalf Honeywell International, Inc. 101 Columbia Road, MEY-3 Morristown, New Jersey 07962
2	Steve Zarlinski CH2M HILL 1700 Market Street, Suite 1600 Philadelphia, PA 19103

Honeywell reserves the right to send one copy of each such document to each of the listed recipients and post each document on a website maintained by Honeywell and accessible to all recipients listed above, in accordance with the AOC.

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Attachment B	TarGOST™ Site Calibration Data
Attachment C	Vibracore SOP

SECTION 1

Introduction and Sampling Summary

1.1 Introduction

This Field Sampling Plan (FSP) describes in detail the sampling and data-gathering methods and procedures to be used during the remedial investigation/feasibility study (RI/FS) field activities at the Quanta Resources Site (the Site) OU2. A detailed description of the Site, the history and background, and a description of the Site-related contamination are provided in Section 1 of the RI/FS Work Plan (Work Plan), to which this FSP is an appendix. This FSP should be used in conjunction with the Quality Assurance Project Plan (QAPP) (Appendix B of the RI/FS Work Plan) to guide all field and laboratory sampling and measurement conducted as part of the RI. Together, the FSP and the QAPP comprise the Sampling and Analysis Plan (SAP) under the CERCLA RI/FS process.

1.2 Sampling Objectives

The main objective of the field sampling is to determine the physical and chemical conditions at the site and their possible impact and risks posed to human health and the environment. In particular, the specific objectives of the RI, as described in the work plan are:

- Identify the potential chemicals of interest (PCOI) that are present in OU2 sediment and surface water at concentrations exceeding regional background levels, and are related to historical activities at the Site.
- Identify the horizontal and vertical boundaries beyond which concentrations of site-related PCOIs do not exceed background threshold values, and coal tar is not present.
- Evaluate the potential for human health and ecological impacts associated with operations at the Site.
- Develop sufficient data for the evaluation of remedial alternatives for OU2, including characterizing the depositional environment and assessing the physical characteristics of sediment that will influence the feasibility of various sediment management approaches.

1.3 Sample Locations, Investigations, and Frequency

Field sampling activities to be conducted in support of the RI for OU2 are described in the following subsections. The sampling objectives and intended data uses are described on Table 1-1 of this FSP. The number of field samples, quality assurance/quality control (QA/QC) samples, the analytical parameters, and the analytical methods are summarized on Table 1-2. See Sections 3, 4, 5, and 6 of this FSP for investigation methods. The locations of sample locations are shown on Figure 5-1 in the Work Plan.

1.3.1 TarGOST™

A dynamic subsurface investigation will be conducted using a Green Optical Screening Tool specifically designed to detect coal tars (TarGOST™). TarGOST™ will be coupled with direct-push drilling techniques to delineate the lateral and vertical extent of non-aqueous phase liquid (NAPL) (specifically coal tar). Additional information on TarGOST™ has been included as Attachment A.

At a minimum, the TarGOST™ survey will be completed at 47 stations in Area A and 10 stations previously characterized using CPT/ROST technology. A TarGOST™-outfitted probe will be driven into the sediment subsurface using a Geoprobe® or similar direct-push drill rig. The TarGOST™ survey will be conducted to a depth of 50 feet depending on drilling conditions. If the lateral extent of coal tar extends beyond Area A or is detected at previous CPT/ROST stations in Area B, the survey will be expanded into Area B as needed. The proposed TarGOST™ boring locations are shown on Figure 5-1 in the Work Plan.

If coal tar is detected at depths greater than 30 feet based on the TarGOST™ survey results, then an attempt will be made to collect deep confirmatory sediment samples with the Geoprobe rig. Confirmatory samples will be collected using the Geoprobe rig equipped with a Macrocore sampler. These samples will be analyzed for the same suite of compounds as the shallow sediment samples, which includes semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), arsenic, chromium, lead, copper, mercury, nickel, silver and zinc.

1.3.2 Sediment Sampling

Surface and subsurface sediment samples will be collected to more fully characterize the nature and extent of contamination associated with operations at the Site. Sediment subsurface samples will be collected to evaluate current and historic conditions in the river's subsurface.

A stratified grid sample design will be used in the OU2 study area for the sediment sampling. Two strata have been defined: A) from the shoreline of the Site to approximately 400 feet offshore (and including the near shore area south of the Kellogg pier), where PCOI concentrations are expected to be highest and concentration gradients are expected to be steepest; and B) the area to the north and east of the A stratum, where PCOI concentrations are expected to be more uniform and similar to regional background levels. A denser grid for the A stratum is desired to support remedial planning (i.e., this is the area most likely to require sediment management).

Prior to sampling a high quality base map will be developed for the grid study area. This mapping will allow for a base map with a fixed true elevation of the river bottom which is needed to establish actual sample locations and sediment depths that are tied into the project datum. Base mapping will be completed with multibeam bathymetry and side scan sonar. The sonar will be used to map large surface features and obstructions.

A systematic grid sampling approach will be used within each stratum:

- A: systematic grid, 100-foot spacing, 47 sample locations
- B: systematic grid, 150-foot spacing, 30 sample locations

Sediment surface samples will be collected from the 77 stations in Areas A and B at a depth of 0-0.5 foot with Vibracore sampler or a grab sampler such as a Ponar dredge or Van Veen grab sampler. The proposed sediment grab sample stations are shown on Figure 5-1 in the Work Plan.

Sediment subsurface samples will be collected at 14 (8 in Area A and 6 in Area B) of the 77 surface stations within the sampling grid with a Vibracore sampler. Sediment samples will be collected from all 14 cores at 10 additional depth intervals: 0.5-1.0 foot, 1-2 feet, 2-4 feet, 4-6 feet, 6-8 feet, 8-10 feet, 12-14 feet, 16-18 feet, 22-24 feet, and 28-30 feet. The 2-foot composite samples from the remaining intervals below 10 feet (e.g., 10-12 feet, 14-16 feet, 18-20 feet, 20-22 feet, 24-26 feet, 26-28 feet) will be archived frozen for potential future analysis. The proposed sediment core sample stations are shown on Figure 5-1 in the Work Plan.

Supplemental sediment sampling will be conducted in the area north of the former gypsum landfill that is adjacent to the Lustrelon and Edgewater Enterprises properties. A variety of historic industrial activities took place there that were unrelated to activities on the Quanta Resources property. Previous sampling detected elevated levels of polynuclear aromatic hydrocarbons (PAHs) in this area. Five additional sediment surface samples will be collected, and at one of the sediment stations, two additional sediment subsurface samples will be collected at depths of 1-2 feet and 2-4 feet. These samples will be analyzed for the same list of analytes as the other sediment samples. The proposed supplemental sediment sample stations are shown on Figure 5-1 in the Work Plan.

Sediment samples will also be collected at locations up- and downstream of the site from similar depositional areas. Twenty samples will be collected in total (ten upstream and ten downstream). These samples will be used to confirm whether contaminants have migrated up- and downstream of the site. Figure 5-2 in the Work Plan presents the location of the up- and downstream samples.

Sediment samples will be analyzed for SVOCs, and PCBs (Aroclors), arsenic, chromium, lead, copper, mercury, nickel, silver and zinc. Physical analyses (grain size, and total organic carbon (TOC)) will also be conducted on all sediment samples. All samples collected within Area A will also be analyzed for TCL volatile organic compounds (VOCs). In addition at the 14 Vibracore locations in Area A and B, samples from the 0-0.5 and 0.5-1 foot intervals will be analyzed for the complete list of PCB congeners (208 congeners). Geotechnical analyses will be collected from five of the 14 core locations in area A and B. At each core location one sample from each 5 foot section will be analyzed for Atterberg limits, specific gravity, water content, organic content, bulk density, self weight consolidation, permeability, and shear strength. Water depth and tidal stage will be recorded at the time samples are collected.

1.3.3 Geochronology

Sediment samples from three cores will be analyzed for Cesium-137. The three cores will be located along a transect perpendicular to the bulkhead at distances of approximately 275, 475, and 750 feet. Samples will be collected to a depth of 15 feet. Cesium-137 activity will be plotted with increasing depth in the sediment core. The first appearance of Cesium-137 will be determined to approximately represent the 1954 time horizon, when atmospheric testing of nuclear devices was initiated. The shape of the Cesium-137 profile will be used to

calculate the degree of physical mixing of the sediment column: if the profile shows a distinct subsurface peak, then the sediment column will be considered relatively stable. A disrupted or uniform activity profile will indicate a more dynamic depositional environment, or anthropogenic disruption (e.g. dredging).

1.3.4 PAH Fingerprinting of Sediment Samples

Sediment samples from all of the areas (grid areas, north of the gypsum landfill, and up- and downriver locations) will also undergo PAH fingerprinting to determine if detected PAHs appear to be related to the coal tar found in OU1. Within the grid areas, PAH fingerprinting will be conducted on a subset of sediment surface samples, as identified in the PAH Fingerprinting Study Work Plan, which will be provided as an addendum to the RI/FS WP.

In the area north of the gypsum landfill one surface sediment sample will undergo PAH fingerprinting.

Upriver and downriver sediment sampling will be conducted to delineate contamination, and identify potential reference areas for the RI/FS. Sediment surface samples will be collected from ten locations upstream and ten locations downstream at 0 to 0.5 foot for consideration as reference locations. PAH fingerprinting will be used to assess the presence of Site-related coal tar in the sediments from proposed background locations. If site-related coal tar is not detected, these locations may be considered as potential reference locations. In addition to the fingerprinting the following criteria will be used for the selection of reference samples:

- Samples will be collected in the same watershed.
- Samples will be of similar substrate with similar grain size and TOC content.
- Location will have the similar salinity and hydrodynamic conditions as the study area.
- Location will have the similar habitat characteristics.
- Samples will not be located near a known outfall or point source of contamination (e.g., known contaminated site, which will be mapped in relation to proposed reference locations).
- Regional sediment analytical data will be considered in selecting a reference location.

SECTION 2

General Guidelines for Field Work

2.1 Health and Safety

CH2M HILL and its subcontractors will abide by Occupational Safety and Health Administration (OSHA) regulations and the Site-specific health and safety plan (HASP) (CH2M HILL, 2006) (presented in Appendix C of the RI/FS Work Plan). General topics covered in the HASP include: site location and scope of work, safety and health risk analysis, field team organization and responsibilities, air monitoring, personal protective equipment, site control measures, decontamination procedures, emergency response plan, and employee training and medical monitoring. The HASP will be kept onsite during all field activities and a copy will be maintained in the project files.

2.2 Underground Utilities

All underground utilities, including electric lines, gas lines, and communication lines, will be identified before starting drilling and other subsurface work. This will be accomplished by contacting New Jersey One Call (One Call): (800) 272-1000. A One Call representative(s) will mark all buried utility lines in the work area. New Jersey state law requires that One Call be notified at least 3 working days, and not more than 10 working days, before subsurface work is conducted. In addition, site representatives for Honeywell will be contacted to identify any other facility utilities, sewer lines, or other obstructions that may pose a risk to health and safety.

Prior to starting the river work the marine drilling firm will complete a multibeam bathymetric survey and side scan sonar survey of the Area A and B grid to map the subsurface and identify debris and obstructions on the sediment surface. The side scan sonar will be used to identify river bottom obstructions such as submerged pilings, sunken vessels or barges, pipelines, cables, and natural features such as rock piles. In addition a magnetometer survey will be completed to identify buried metal, pipes, or cables.

2.3 Field Log Books

The Field Team Leader will record information pertinent to field activities in a field logbook. The front cover or first page of the field log book will list the project name, project number, and dates of use. Entries in the field log book will be made in real time, signed, and dated by the Field Team Leader at the end of each day. Unused pages or portions of pages will be lined out, dated, and initialed to prevent entry of additional information later. Field log book pages, as well as the log books themselves, will be numbered consecutively. The following information will be included in field log books:

- Date, time of specific activities, and physical location
- Weather conditions
- Names, titles, and organization of personnel onsite, names and titles of visitors, and times of visits
- Field observations; details on sampling activities, including type of sampling, time of sampling, and sample numbers; station coordinates, water depth and tidal stage at time of sampling; a description of field tests and their results; and references to field forms used and/or type of document generated
- A detailed description of samples collected and splits, duplicates, matrix spikes, or blanks that were prepared, and a list of all sample identification numbers
- Specific problems, including equipment malfunctions and their resolutions
- Unexpected or adverse field conditions that may inhibit the field team's ability to perform the day's activity or that may affect the accuracy of the data collected
- Decontamination and calibration of sampling equipment
- Equipment descriptions by type, model number, and serial number, and may include pH meters, conductivity (EC) meters, turbidity meter, and health and safety monitoring equipment

Additional information may be recorded on field data log sheets (data sheets) at the discretion of the log book user.

2.4 Standard Field Data Forms

Standard forms will be used in addition to the field log books and provide a more detailed second record. They ensure that necessary data are recorded consistently. No blank spaces will appear on completed forms. If information requested is not applicable, the space will be marked with a dashed line or marked "N/A." All forms are to be completed in the field and placed in the project files. The following standard field data forms will be completed as necessary:

- Sediment Sampling Field Data Sheets will document percent recovery, sediment type, color, moisture content, texture, grain size and shape, consistency, visible evidence of staining, and any other observations. The sediment descriptions will be in accordance with the ASTM D2488 and colors will be designated using the Munsell color chart.

2.5 Permits

The Site is a CERCLA site and therefore, according to Section 121 (e) of CERCLA, no federal, state or local permit shall be required for the portion of any removal or remedial action conducted entirely onsite, where such remedial action is selected and carried out in compliance with this section. However, the substantive requirements of all applicable

permits will be complied with. The following permits are applicable to the work described herein:

- U.S. Army Corps of Engineers New Jersey ENG Form 4345
- U.S. Army Corps of Engineers Coastal Zone Form and the Environmental Questionnaire
- U.S. Army Corps of Engineers Nationwide Permit
- New Jersey Department of Environmental Protection (NJDEP) Waterfront Development Permit
- NJDEP Land Use Coastal Zone Management Rule Chapter 7E – submit a work plan that describes how work will comply with subchapters 3, 4, and 8
- NJDEP Land Use Department – Waterfront Development Permit
- National Oceanic and Atmospheric Administration (NOAA) – consult regarding essential fish habitat areas
- NOAA – consult endangered species coordinator

In addition, access agreements shall be obtained prior to working on surrounding properties.

SECTION 3

Procedures for Field Equipment Decontamination, Waste Management, and Equipment Calibration

3.1 Equipment Decontamination

Decontamination of non-dedicated and non-disposable sampling equipment will be conducted at the decontamination station onshore or on the boat between locations as necessary. Decontamination on the vessel will be completed using buckets and tubs. Prior to sampling, all bowls, spoons, augers, Vibracore aluminum core barrels and Tygon liners, Geoprobe rods, and Macrocore samplers (usually dedicated) will be washed in potable water and phosphate-free detergent (e.g., Alconox). Disposable bowls and spoons may be used in place of stainless steel bowls and spoons. The sampling equipment will then be rinsed with potable water followed by a dilute nitric acid rinse and hexane rinse, followed by a distilled water rinse. Between rinses, equipment will be placed on polyethylene sheets or aluminum foil if necessary. Geoprobe equipment may also be steam-cleaned, if appropriate. Sampling equipment will be wrapped in aluminum foil for storage or transportation from the designated decontamination area to the sample locations. Decontaminated equipment will not be placed directly on the ground surface. To minimize the time spent in the field and reduce the opportunity for cross-contamination, the sampling team will have sufficient clean equipment available to complete a sampling round without excessive delays.

3.2 Management of Investigation-Derived Waste

Investigation-derived waste will be handled and disposed of according to the CH2M HILL Waste Management Plan for the Site.

Wastewater and IDW generated during sampling events will be contained in Department of Transportation (DOT) approved, steel, type 17-H (ring-lock top) 55-gallon drums. These drums will be stored temporarily at the Site until they are picked up by the disposal subcontractor (e.g., Clean Harbors). Non-hazardous debris, such as packing material, paper trash, or clean personal protective equipment (PPE) waste, will be disposed of as regular waste.

3.3 Field Instrument Calibration

All field screening and sampling instruments (e.g., fathometer, YSI meter and photoionization detector [PID]) that require calibration before operation will be calibrated daily in accordance with the manufacturer's instructions. All instrument calibrations will be

documented in the field log book for the various pieces of equipment. Instrument operating manuals will be maintained onsite by the field team.

3.4 Maintenance Procedures

Non-consumable field equipment (YSI meter, GPS unit, PID, etc.) will be rented from US Environmental Rental Corporation (US Environmental). Maintenance of this equipment will be performed by US Environmental. If maintenance is required on a piece of equipment, US Environmental will switch out that piece of equipment so that the maintenance can be performed without delaying the field work. Basic maintenance such as changing batteries will be performed by the field team.

SECTION 4

Sampling Equipment and Procedures for Field Sample Collection

4.1 Introduction

Procedures for obtaining samples of various environmental media are described in this section. Sample handling and procedures are described in Section 6.

4.2 Sediment Samples

Sediment samples will be collected from a boat or barge using a Vibracore sampler, a Geoprobe rig, or a grab sampler. Deep sediment core samples will be collected with the Vibracore or Geoprobe rig. While shallow sediment samples will be collected with a grab sampler (Ponar dredge or Van Veen sampler) or with the Vibracore rig. Sediment samples for laboratory analyses will be collected in accordance with the NJDEP Field Sampling Procedures Manual (2005).

Methods described below are in accordance with the CH2M HILL Vibracore Sediment Sampling SOP which is included in Attachment C:

- Sediment samples will be collected after surface water samples, if surface water and sediment samples are to be collected from the same locations.
- Sample locations will be surveyed with a GPS unit from the barge.
- The water depth at each sample location and tidal stage will be recorded in the field log book.
- Sediment samples will be collected using a Vibracore rig on a boat to push a continuous 30 foot core tube sampler into the sediments to the desired sample depth. The sampler will then be retracted and the inner Tygon core tube liner will be removed. The sample tube will be cut into 5 foot segments, capped, iced, and transported to shore.
- Sample description, depth, location, and time of sampling will be recorded on the Sediment Sampling Field Data Sheet (Figure 5-1) and in the field log book.
- Prior to collecting samples for chemical analysis from cores, the cores will be described by a geologist following ASTM Procedure D2488-84 (ASTM 1984). The geologist will log features such as sediment type (engineering classification) color, consistency, sedimentary structure, maximum particle size, and odor. This information is recorded on a Core Geologic Data form. The geologist will also note the depth(s) at which significant changes or inclusions (wood debris, shell hash, sand layers) occur in the core, and the intervals from which sub-samples were removed. Each core will be photographed.

- Sediment surface samples will be collected at a depth of 0-0.5 foot. Grab sample collection procedure is described in Section 5.2.1.
- Sediment subsurface samples will be collected at 10 additional depth intervals: 0.5-1.0 foot, 1-2 feet, 2-4 feet, 4-6 feet, 6-8 feet, 8-10 feet, 12-14 feet, 16-18 feet, 22-24 feet, and 28-30 feet.
- Core sections will be stored upright after collection and transported to shore for processing. Cores will be kept cold while on the boat. If cores cannot be processed immediately after sampling, they shall be stored in refrigerated truck or large cooler.
- The core will be processed and sub-sampled in accordance with the procedure described in Section 5.2.2.
- Sediment samples will be screened for the presence of vapors in accordance with procedures described in this section.
- Sediment samples will be visually described for: 1) percent recovery, 2) soil type, 3) color, 4) moisture content, 5) texture, 6) grain size and shape, 7) consistency, 8) visible evidence of staining, and 9) any other observations. The soil descriptions will be in accordance with the ASTM D2488 and colors will be designated using a Munsell color chart.
- After characterization, each core will be divided into specific sample intervals, which are collected, homogenized, and placed into pre-cleaned, labeled containers for the appropriate analyses. Sediment that is in direct contact with the core liner will not be collected.
- The sediment samples will be thoroughly mixed with a stainless steel spoon in a stainless steel bowl and then placed into the appropriate sample containers.
- Composite and duplicate sediment samples, and matrix spike/matrix spike duplicate/matrix duplicate (MS/MSD/MD) samples will be prepared by mixing the sediment with a stainless steel spoon in a stainless steel bowl, and splitting the mixed sediment.
- The sample containers will be labeled, placed in a laboratory-supplied cooler, packed on ice (to maintain a temperature of 4° C), and shipped overnight or by laboratory courier to the laboratory for analysis.
- Chain-of-Custody (COC) procedures will be followed.
- The equipment will be decontaminated between samples in accordance with procedures described in Section 3. Disposable scoops and aluminum pans may be used in place of stainless steel spoons and bowls.

4.2.1 Grab Sample Collection

Surface sediment samples will be collected with a small vessel and a Van Veen grab sampler. The survey crew will implement the following activities as part of grab sample collection procedures:

- thorough wash-down of the grab before each deployment
- control of penetration by adding or removing weights to the frame and adjusting descent rate

The following sampling procedures will be used:

1. Attach the sampler to the hydrowire using ball-bearing swivel.
2. Open the sampler and lock into position.
3. Once on station, place the sampling in the water and lower slowly to the bottom.
4. When the sampler strikes the bottom, let out a small amount of slack; then slowly retrieve the cable, thereby closing the sampler jaws.
5. Retrieve the sampler slowly from the water and secure it aboard the vessel.
6. Open the access doors of the sampler and determine if sufficient penetration depth was achieved.
7. Inspect the surface of the sediment to determine if the sample is acceptable. If the surface shows signs of disturbance (channeling, loss of surface integrity), discard the sample (into a waste container to avoid re-sampling). Sediment samples are considered acceptable if they meet the following criteria:
 - Sampler is not overfilled with sediment; the jaws are fully closed and the top of the sediment is below the level of the opening doors.
 - Overlying water is present and not excessively turbid.

In certain locations slight over-penetration may be accepted at the discretion of the chief scientist. Mild over-penetration may be accepted according to the following standards:

- Sediment surface is intact on at least one side of the grab
- Little or no evidence of surface sediment pushing through the grid surface of the grab, *i.e.*, no visible imprint from the screening outside of that grid.

Once an acceptable grab is collected, the overlying water will be removed using a clean siphon hose, taking care not to disturb the sediment surface. The upper 6 inches will be scooped from the top of the grab using a pre-cleaned stainless steel spoon or scoop, placed in a pre-cleaned 2-L glass jar, and chilled immediately. One acceptable, undisturbed grab sample will be sufficient to provide the quantity of sediment needed for the proposed chemical analysis. The sediment will be sampled only from the inner portion of the grab, avoiding all sediment that is in actual contact with the wall of the grab.

4.2.2 Core Processing Procedure

The sample will be removed from the core using a stainless steel spoon and placed in a stainless steel mixing bowl. Free water will be decanted off. Rocks and vegetative material will be discarded, and care taken to retain fine materials which tend to disperse when disturbed. Sediment cores will be sub-sampled onsite using the following guidelines:

- Place the core on a non-contaminating surface.
- Using a circular saw, cut the core longitudinally, scoring the liner but not cutting completely through it. Rotate the core 180° along its axis and repeat.
- Gently pass a clean stainless steel knife along both scored sections, cutting completely through the liner. Alternatively, aluminum snips can be used to cut through the core liner.
- Gently open the core longitudinally into two equal halves.
- Carefully remove any pieces of liner in contact with sediment.

4.3 Geochronology Samples

Calculating the geochronological age of the sediment at different depths will be based on radioisotope activity to evaluate the depositional profile and stability of sediments at various locations in the study area. Each sediment core will be tested for radioactive isotope activity, specifically Cesium-137. Cores to be collected will be targeted at the 0- to 15-foot depth interval. The following procedures will be implemented for collecting sediment cores for geochronological analysis:

- At three of the 14 deep core locations a portion of the core will be used for geochronology analysis. At each station a Vibracore sampler will be used to collect sediment to a depth of 30 feet. Geochronology testing will only be completed on a portion of the top 15 feet.
- The core will be maintained in vertical orientation to avoid disruption of the vertical layering of the cores.
- Immediately upon collection, these cores will be placed upright into a refrigerator or freezer. Samples will be processed on the day of collection or stored overnight in the refrigerator.
- After the cores are frozen overnight, they will be transferred to a clean table for segmentation. A jig saw will be used to cut the core segments to match the segmentation design.
- The core tubes will be split longitudinally and sectioned into 2-centimeter (cm) intervals for the top 30 centimeters (cm) (approximately 1 foot), and 10-cm intervals thereafter.
- Sample aliquots will be transferred to 100-milliliters (mL) sample jars, labeled by core ID and depth interval, and placed on ice in coolers and out of direct sunlight. Any unused sediment will be replaced back into the core. Care will be taken to preserve the water content of core segments during transfer to the sample bottles.
- Every third segment from the top 30 cm will be shipped to the laboratory (for a total of 5 segments in the top 30 cm). The remaining segments (10 segments in the top 30 cm) will be archived until the radioisotope data received have been evaluated. If the evaluation shows that additional data are necessary, these archived samples will be sent for radio isotope dating also.

- COC procedures will be followed.
- The equipment will be decontaminated between samples in accordance with procedures described in Section 3. Disposable scoops and aluminum pans may be used in place of stainless steel spoons and bowls.

4.4 TarGOST™ Survey

TarGOST™ is a down-hole laser-induced fluorescence screening tool developed and operated by Dakota Technologies of Fargo, North Dakota (Dakota Technologies). It is specifically designed for use with direct-push drilling techniques to detect NAPL in the subsurface and responds almost exclusively to coal tars and creosote by sensing the fluorescence of PAHs found in these types of NAPLs. Additional information on TarGOST™ has been included as Attachment A.

The probe will emit rapid pulses of green laser light and will measure the subsequent fluorescence response of the soils in an adjacent window as it is deployed into the subsurface. Return data will be converted into digital values that are presented as color-coded, scaled graphical logs in real time. The amount of NAPL present relative to other depths and locations will be determined through the regular calibration of the system to a known fluorescence emitting reference (RE) material prior to each sounding. The resulting down-hole data will then be plotted as a function of depth and viewed in context of the RE.

To confirm the suitability of TarGOST™ for detecting these Site-specific NAPLs, a small volume of each of the NAPL samples collected during OU1 RI activities was sent to Dakota Technologies, where its fluorescence response was tested using TarGOST™ and Ultra-Violet Optical Screening Tool (UVOST™) (formerly known as Rapid Optical Screening Tool, or ROST™). UVOST™ detects typical bulk petroleum, fuels, and light oils. Results of this evaluation indicated that TarGOST™ would be an effective tool (significantly more effective than UVOST™) for detecting the types of NAPLs that have been observed at the Site and that are believed to be related to operations at the former Quanta Resources property. Results of the TarGOST™ evaluation of Site-specific NAPLs are included as Attachment B.

Survey Method:

- All appropriate permits, and forms will be completed as required by NJDEP.
- The probe will be advanced to the specified depths (up to 50 feet) using direct push-type drilling methods.
- All drilling equipment will be decontaminated between each core in accordance with methods specified in Section 3.1.

Deep Confirmatory Sediment Sample collection:

- If coal tar is detected at depths of greater than 30 feet with the TarGOST™, an attempt will be made to collect a confirmatory sediment sample with the direct push rig (i.e., Geoprobe™ or equivalent).
- Confirmatory sediment samples will be collected with a Geoprobe™ Macrocore (or equivalent). The direct push rod will be advanced to the selected depth. A Macrocore

will be installed on the direct push rods and pushed to the appropriate depth, and then pushed to collect a sample. Use of a direct push rig in soft sediment can be difficult. The driller may have to set an outer casing and then push the direct push rods through this casing.

4.5 Quality Control Samples

QC samples can be divided into four categories: equipment rinsate blank (EB), trip blank (TB), field duplicate (FD), and MS/MSD. The collection of quality control samples is further discussed in the QAPP, which is provided in Appendix B to the Work Plan.

Sample Handling and Analysis

5.1 Sample Designation

Each sample will be given a unique alphanumeric identifier in accordance with the classification system shown in Table 5-1. Duplicate samples will be assigned identifiers that do not allow the laboratory to distinguish them as duplicates. Each sample container will be labeled prior to packing for shipment. The sample identifier, site name, date and time of sampling, and analytical parameters will be written on the label in waterproof ink and recorded in the field log book.

5.2 Sample Containerization, Preservation, and Analysis

Sample containerization, holding time requirements, and preservation requirements are listed in Section 4 of the QAPP. Field handling and storage of samples and sample containers is described in Section 5 of the QAPP. Analytical methods for sample analyses are listed in Section 7 of the QAPP.

5.3 Chain-of-Custody

A COC record (Figure 6-1) will accompany the sample containers during selection and preparation at the laboratory, during shipment to the field, and during return shipment to the laboratory. The COC will identify each sample container and the analytical parameters for each, and will list the field personnel who collected the samples, the project name and number, the name of the analytical laboratory that will receive the samples, and the method of sample shipment. If samples are split and sent to different laboratories, a copy of the COC record will be sent with each sample shipment.

Method:

- The COC record will be completed by field personnel as samples are collected and packed for shipment.
- Erroneous markings will be crossed-out with a single line and initialed by the author.
- The Special Instructions space will be used to indicate if the sample is an MS/MSD/MD.
- TB and FD will be listed on separate rows.
- After the samples have been collected and sample information has been listed on the COC form, the method of shipment, the shipping cooler identification number(s), and the shipper air bill number (if necessary) will be entered on the form.

- Finally, a member of the sampling team will write his/her signature, the date, and time on the first "RELINQUISHED BY" space. Duplicate copies of each COC record must be completed.
- One copy of the COC record will be retained by sampling personnel (and later transmitted to the OU2 project lead for filing with a copy sent to the Project Chemist). The other copy and the original will be sealed in a plastic bag and taped inside the lid of the shipping cooler.
- Blind duplicate samples will be cross referenced to the corresponding field sample only on the copy of the COC record retained by the sampling personnel. The samples will remain blind samples on the two copies of the COC record sent to the laboratory.
- Sample shipments going to chemical analytical laboratories will be refrigerated at 4°C, typically by packing with ice, to preserve the samples during shipment. Samples going to geotechnical labs for geotechnical analyses will not require refrigeration.
- After the shipping cooler is closed, custody seals provided by the laboratory will be affixed to the latch and across the front and back of the cooler lid, and signed by the person relinquishing the samples to the shipper.
- The seal will be covered with clear tape, and the cooler lid will be secured by wrapping with packing tape.
- Then the cooler will be relinquished to laboratory or the shipper, typically an overnight carrier.
- The COC seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the CH2M HILL Project Chemist, and the samples will not be analyzed.
- The chemical analytical samples must be delivered to the laboratory within 48 hours of collection.

5.4 Sample Documentation

The Field Team Leader will retain a copy of the COC record and also will ensure that the following information about each sample is recorded in the field book or sample log:

- Sample identifier
- Sample identifier of blind duplicate samples and cross-reference to corresponding field sample
- Identification of other QA/QC samples and cross-reference to corresponding field samples
- Identification of sampled media (soil, sediment, surface water)
- Sample location with respect to known reference point
- Physical description of sample location

- Field measurements, (pH, temperature, EC, and water levels)
- Date and time of collection
- Sample collection method
- Number of sample containers
- Analytical parameters
- Preservatives used
- Shipping information
 - Dates and method of sample shipments
 - COC record numbers
 - FedEx air bill numbers (if necessary)
 - Sample recipient (laboratory name)

SECTION 6

References

American Society of Testing and Materials. D2488-00, *Standard Practice for Description and Identification of Soils (Visual – Manual Procedure)*

New Jersey Department of Environmental Protection. 2005. *Field Sampling Procedures Manual*. Trenton, NJ.

New Jersey Department of Environmental Protection. 1998. *Guidance for Sediment Quality Evaluations*. Trenton, NJ.

Tables

Table 1-1
Sampling Objectives and Data Uses
Quanta Resources Site
Edgewater, New Jersey

Sampling/Monitoring Activity	Objective	Intended Data Usage
<u>Sediment Surface Sampling</u>	Collect grab samples at 77 stations within the sampling grid at a depth of 0 - 0.5 ft.	Data will be used during the RI assessment to evaluate and delineate NAPL and COC potential impacts to sediments in the Hudson River (OU2). The data will also be used for the risk assessment.
<u>Sediment Subsurface Sampling</u>	Collect subsurface samples at 14 of the 77 stations within the sampling grid at 10 depth intervals: 0.5 - 1.0 ft, 1 - 2 ft, 2 - 4 ft, 4 - 6 ft, 6 - 8 ft, 8 - 10 ft, 12 - 14 ft, 16 - 18 ft, 22 - 24 ft, and 28 - 30 ft.	Data will be used during the RI assessment to evaluate and delineate NAPL and COC potential impacts to sediments in the Hudson River (OU2). The data will also be used for the risk assessment.
<u>Supplemental Sediment Sampling in Former Gypsum Landfill Area</u>	<p>Collect five sediment surface samples at a depth of 0 - 0.5 ft and sediment subsurface samples at one of the stations at 10 depth intervals: 0.5 - 1.0 ft, 1 - 2 ft, 2 - 4 ft.</p> <p>Perform PAH fingerprinting on one surface sample to confirm the presence or absence of site-related coal tar PAH compounds in the sediments.</p>	Data will be used to determine if the PAHs detected in this area at elevated levels in previous sampling events are related to the coal tar found in OU1.
<u>Sediment Surface Sampling to Identify Reference Location</u>	<p>Collect sediment surface samples from 10 locations upstream and 10 locations downstream at 0 - 0.5 ft for consideration as reference locations.</p> <p>Perform PAH fingerprinting on the samples to confirm the presence or absence of site-related coal tar PAH compounds in the sediments.</p>	Data will be used to identify a reference area for the Baseline Ecological Risk Assessment (BERA).

Table 1-2
Summary Of Samples And Analyses
Quanta Resources Site
Edgewater, New Jersey

<u>Sample Description</u>	<u>Sample Depth</u>	<u># of Samples</u>	<u>QA/QC Samples</u>	<u>Parameter</u>	<u>Analytical Method</u>
<u>Sediment Surface Samples</u>	0 - 0.5 ft	77 locations within grid	MS/MSD (4 pair) Duplicate (5) Trip Blank (per SDG)	<u>Chemical</u> VOCs SVOCs PCBs PCB congeners for 14 locations Metals (arsenic, lead, chromium, copper, mercury, nickel, silver, zinc) <u>Physical</u> Grain Size Distribution TOC	SW-846 8260B SW-846 8270C SW-846 8082 EPA 1668 SW-846 SW6010B/7000 Series ASTM D-422 SW-846 9060
<u>Sediment Subsurface Samples</u>	0.5 - 1.0 ft 1 - 2 ft 2 - 4 ft 4 - 6 ft 6 - 8 ft 8 - 10 ft 12 - 14 ft 16 - 18 ft 22 - 24 ft	14 out of 77 locations within grid	MS/MSD (4 pair) Duplicate (4) Trip Blank (per SDG)	<u>Chemical</u> VOCs SVOCs PCBs PCB congeners for 14 locations for top 2 depths Metals (arsenic, lead, chromium, copper, mercury, nickel,	SW-846 8260B SW-846 8270C SW-846 8082 EPA 1668 SW-846 SW6010B/7000 Series

Table 1-2
Summary Of Samples And Analyses
Quanta Resources Site
Edgewater, New Jersey

Sample Description	Sample Depth	# of Samples	QA/QC Samples	Parameter	Analytical Method
<u>Supplemental Sediment Subsurface Samples in area north of Former Gypsum Landfill Area</u>	0.5 - 1.0 ft 1 - 2 ft 2 - 4 ft	1 of the 5 surface locations, one sample will be collected at each interval	Trip Blank (per SDG)	<u>Chemical</u> SVOCs PCBs Metals (arsenic, lead, chromium, copper, mercury, nickel, silver, zinc) <u>Physical</u> Grain Size Distribution TOC	SW-846 8270C SW-846 8082 SW-846 SW6010B/7000 Series ASTM D-422 SW-846 9060
<u>Sediment Surface Sampling to Identify Reference Location</u>	0 - 0.5 ft	10 upstream, 10 downstream	Trip Blank (per SDG)	<u>Chemical</u> VOCs SVOCs PCBs Metals (arsenic, lead, chromium, copper, mercury, nickel, silver, zinc) <u>Physical</u> Grain Size Distribution TOC	SW-846 8260B SW-846 8270C SW-846 8082 EPA 1668 SW-846 SW6010B/7000 Series ASTM D-422

Table 5-1
Sample Designation
Quanta Resources Site
Edgewater, New Jersey

SAMPLE IDENTIFIER:

<u>Sample Type -</u>	<u>Sample Number -</u>	<u>Depth Code -</u>	<u>Date</u>
LL	NN	N.N-N.N	MMDDYY

L = Letter
N = Number
M = Month
D = Day
Y = Year

SAMPLE TYPE:

SD - Sediment

SAMPLE NUMBER:

NN - Station number from Figure 5-1 in the Work Plan.
FD - Duplicate
TB - Trip Blank
EB - Equipment Rinsate Blank

DEPTH CODE:

Depth in feet of sample interval: (example, 4.0-4.5).

DATE:

Month, day and year that the sample was collected.

Figures



PROJECT NUMBER

SHEET

OF

SEDIMENT LOG

PROJECT:

STATION ID


Time;

LOGGER:

DATE (MM/DD/YYYY):

[illegible]

1 - Soil particle percentages are estimated based on visual observations.

Lab Name				Honeywell														Chain Of Custody / Analysis Request														AESI Ref: 38954.60550	
Lab Address1																		COC# 30916-051606															
Lab City, Lab State Lab Zipcode																		Lab Proj # (SDG):															
Lab Telephone																		Lab ID Lab Id															
Sampling Co.: CH2M HILL				EDD To: amy.klopper@ch2m.com, john.mitchell@ch2m.com				Site Name: Quanta Resources (Edgewater)				Phase: Sampling Program				Quanta 2006 Groundwater				Site ID Quanta													
Client Contact: (name, co., address)				Sampler: Austin Hareclerode/CH2M HILL				Location of Site: Edgewater, NJ								Lab Job #				Authorized User: Honeywell													
				PO #				Preservative												Text & Excel File Drive Excel & Text File Order													
				Analysis Turnaround Time (TAT): 10																Copyright AESI: Version 8.0 Unauthorized use strictly prohibited.													
				Consultant CH2M																													
Preliminary Data To								Composite/Grab Field Filtered Sample ?																									
Sample Receipt Acknowledgement To																																	
Hard Copy To																																	
Invoice To:																																	
Full Report TAT:																																	
Sample Identification				Sample Date				Sample Time				Sample Type				Sample Matrix				Sample Purpose				# of Cont.									
Location ID				Start Depth (ft)				End Depth (ft)				Field Sample ID																Sampling Method (code)		Lab Sample Numbers			
1																																	
2																																	
3																																	
4																																	
5																																	
6																																	
7																																	
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9																																	
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12																																	
SW6010*LLI																																	
Relinquished by				Company CH2M HILL				Received by				Company				Condition				Custody Seals Intact													
				Date/Time								Date/Time				Cooler Temp.																	
Relinquished by				Company				Received by				Company				Condition				Custody Seals Intact													
				Date/Time								Date/Time				Cooler Temp.																	
Preservatives: (Other; Specify):								0 (none); 1 (4 Deg C); 2 (HCl pH<2); 3 (HNO3 pH<2); 4 (H2SO4 pH<2); 5 (NaOH pH>12); 6 (NaOH, Zn Acetate); 7 (H2SO4 (pH<2), 4 Deg C)); 8 (HCl pH<2); 9 (HCl 4 Deg C); 10 (HNO3 (pH<2), 4Deg C); 11 (4C NaOH (pH>12) & Ascorbic Acid); 12 (4C H2SO4 (pH<2) & Na2S2O3); 13 (Zn Acetate); sp (special instructions)																									

Attachment A
TarGOST Additional Information

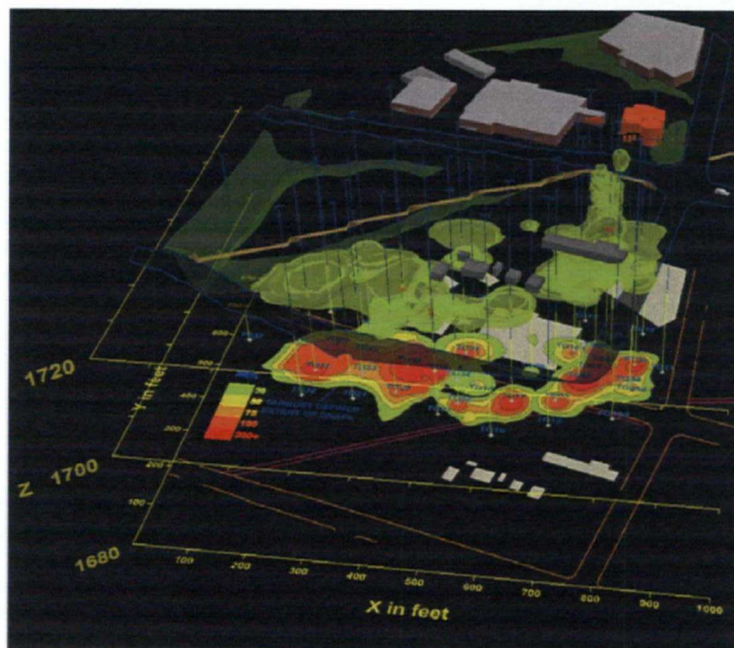
DAKOTA TECHNOLOGIES, INC.

TarGOST™/ROST Data Visualization Service

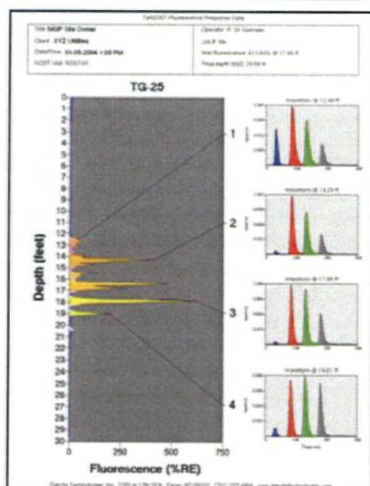
- Enables better decisions for site assessment and remediation
- Provides comprehensive and high quality communication tool
- Saves time and money

Description

Dakota Technologies has developed the capability to easily visualize Tar-specific Green Optical Screening Tool (TarGOST™) and Rapid Optical Screening Tool (ROST) site characterization data. ROST delineated petroleum, oil and lubricant contaminants while TarGOST specifically delineates coal tars and creosote contaminants in the subsurface. Dakota now provides the capability to view TarGOST/ROST site characterization data in static or dynamic format with unparalleled resolution. Dakota can also overlay the site with aerial photographs or building CAD models over GIS terrain data to provide an accurate overall picture of the site with relevant subsurface features.



Technology



TarGOST/ROST data logs are typically acquired at 1 inch vertical resolution which is orders of magnitude higher resolution than traditional sampling methods. Dakota's key advantage is high accuracy in the contamination models. When visualized in 3-D, contaminants migrating in narrow seams or "stringers" of sand, silt, or gravel are easy to see. TarGOST's/ROST high data density reveals these types of contaminant distribution features often missed by conventional methods.

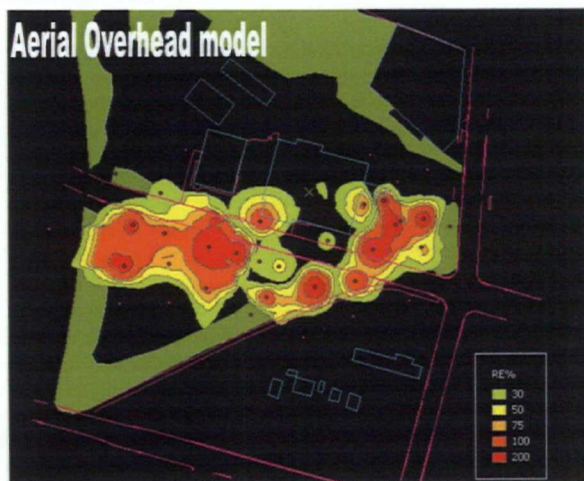
Dakota's interpolation algorithms combined with the high density TarGOST/ROST data produces a high correlation between individual TarGOST/ROST data logs (shown at left) and the 3-D source term model.

DAKOTA TECHNOLOGIES, INC.

Features

- 2-D (fence or cross section) and 3-D models such as Plume and Stick provide a variety of methods to best represent the log data
- Choose a variety of display formats including static graphics and dynamic video
- Overlay site aerial photographs or satellite images onto the model
- Integrate Dakota's visual models with client's existing AutoCAD drawings
- Fast turn-around time

Sample Models



High Resolution

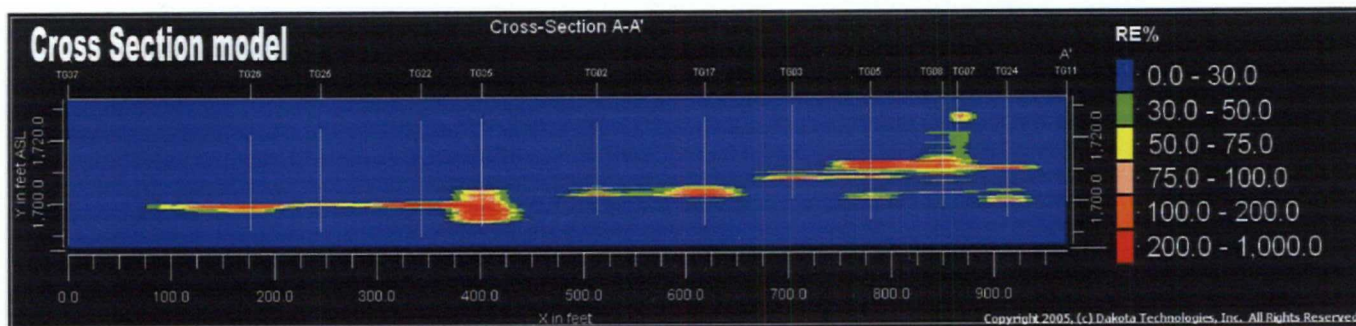
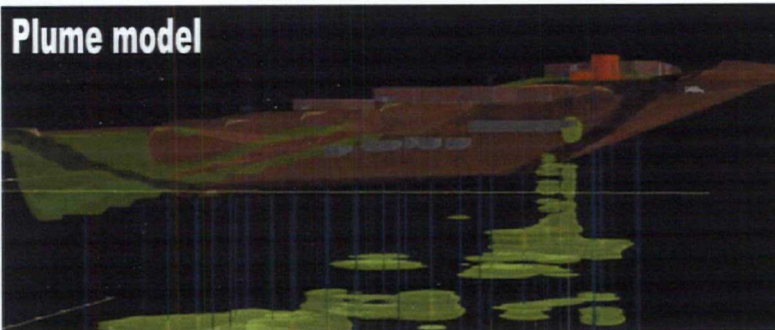
- Vertical resolution less than 1 inch
- Log interpolation between direct push locations using a highly accurate modeling algorithm

Customizable

- Static visualization of subsurface features to ease data interpretation
- Dynamic full 360 degree fly-by video
- Add surface contour and buildings to gain perspective and ease data interpretation

Save Time & Money

- Optimize placement of validation sampling and treatment technologies
- "Machine Vision" eliminates subjectivity typical during boring analysis



Value

- Visualize the "big picture"
- Superior communication tool
- Consultants can produce high quality results for their clients

TarGOST User's Guide

The Tar-specific Green Optical Screening Tool (TarGOST™) is a laser-induced fluorescence (LIF) screening tool that is specifically designed to detect non-aqueous phase liquid (NAPL) in the subsurface. It responds almost exclusively to the NAPL found at former manufactured gas plants (MGPs) and creosote/pentachlorophenol sites. It does this by sensing the fluorescence of polycyclic aromatic hydrocarbons (PAHs) found in MGP and creosote NAPLs. TarGOST is a modification of the Rapid Optical Screening Tool (ROST). Dakota developed the ROST early in the 1990's with U.S. Air Force funding. The ROST platform is a mature technology that has been applied at hundreds of petroleum, oil, and lubricant (POL) contaminated sites in the U.S., Europe, and Japan since 1994. TarGOST has been in commercial use since March, 2003.

General TarGOST Principles

The TarGOST system is, in its simplest sense, a front-face fluorometer that is coupled via fiber optics to a sapphire-windowed probe that is shoved into the ground. A front-face fluorometer is a device that shines excitation light onto, and collects emission from, the same surface. This is different from standard fluorometers, which operate with the excitation and emission beams at 90°. The TarGOST system makes continuous front-face fluorescence measurements of the soil matrix as the windowed probe is pushed slowly down into the subsurface.

The fluorescence measurements are made 20 to 50 times each second (20 to 50 Hz). Each individual measurement begins with a pulse of laser excitation light being launched into one of two fiber optic cables that are strung through the drill/push rod string. As the rod is advanced into the subsurface, the very fast pulses of laser light (10 nanoseconds in duration) are directed out the sapphire window and onto the soil surface that is pressed very firmly against the outside of the window. The pulses of green light strike whatever is present just outside the surface of the window. Most of the laser light is simply reflected by the soil matrix. However, if oil-like material (OLM) or tar-like material (TLM) associated with former MGP processes is present, the PAHs that exist in these NAPLs absorb some of the light and are driven into an electronically excited state. When these PAHs eventually return to the ground state (this typically takes less than 10 ns), a portion of the PAHs emit red-shifted light (longer wavelength light than the excitation laser). Some of this fluorescence, along with a small portion of the reflected excitation laser light, are collected by a mirror and focused into the second collection fiber optic for return to the TarGOST instrument for detection.

The return light is directed into a spectrometer located inside the TarGOST system. A grating in the spectrometer disperses this light into a "rainbow" across the back plane of spectrometer. Four optical fibers are located in this backplane. One of the fibers collects a small portion of the relatively intense laser light (more about this laser scatter channel later) while the other three fibers capture bands of the fluorescence (~10nm wide) emitted by any PAHs present in the NAPL. The four fibers are different lengths so that each fiber delivers its 'packet' of fluorescence photons to the photomultiplier tube (PMT) at delayed time intervals. The result is a "train" of time delayed photon packets all arriving at the same PMT over a period of 300 nanoseconds (ns). The PMT is a device that converts photons into a current pulse. This current pulse

is wired into a fast digital storage oscilloscope where it is converted into a transient voltage signal, is digitized, and recorded. This digitized transient is called a waveform. The laser light that is being reflected from the soil matrix is monitored in the first channel (left-most) and the three fluorescence bands are observed in the three right-most channels.

Figure 1 illustrates waveforms that are typical of those generated with TarGOST. If the soil is clean of NAPL, the laser scatter channel (leftmost) is far more intense than the three fluorescence channels. The Clean Sand waveform in Figure 1 illustrates what clean (or very low NAPL) soil typically looks like on the TarGOST system. If NAPL is present, the fluorescence channels begin to grow in comparison to the laser channel. The 1000 ppm waveform in Figure 1 illustrates such a condition. The more coal tar present, the lower the scatter channel gets and the higher the three fluorescence channels get. Finally, with pure NAPL on the window, the greatest increase in the fluorescence channels is observed, along with maximum loss of signal in the laser reflectance channel – due to absorbance by the PAH-laden NAPL. The NAPL waveform in Figure 1 illustrates the waveform resulting from such a condition.

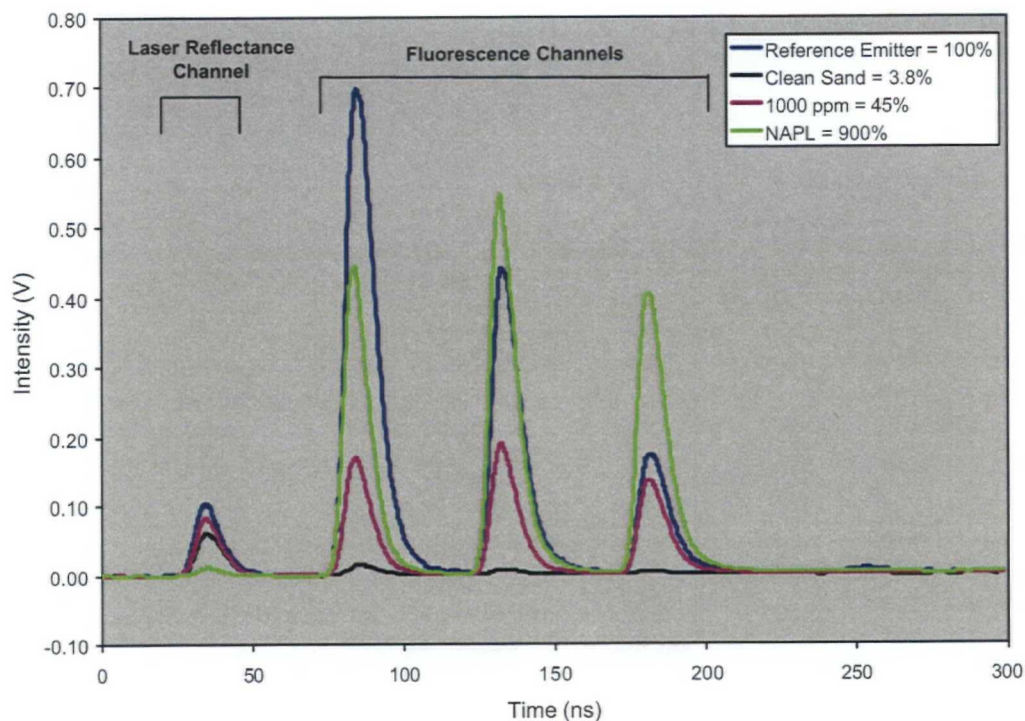


Figure 1. Example TarGOST waveforms.

Calibration/Normalization

The waveform shapes (the relative amount of signal in each channel and the decay time on the right side of each peak) tell us quite a bit about the qualitative nature of what's happening outside the window. But what interests people most is the **amount** of NAPL that is present vs. depth. We do this by portraying the fluorescence vs. depth (FVD) in a continuous log format. To accomplish this we must reduce the 2-D waveform to a single quantitative number. We also need to normalize for any energy drift of the laser and optical alignment changes, so it is necessary to calibrate the system prior to each sounding and plot the downhole data relative to a known fluorescence emitting reference (RE) material. The RE is a stable and known material that can be applied to the window and measured just prior to each sounding. The fluorescence of the downhole data, relative to this RE, is then plotted as a function of depth.

Figure 2 graphically illustrates the calibration procedure. The RE both reflects some of the laser light and fluoresces at levels that are in the same general range as soils that are moderately to heavily contaminated with MGP NAPL. The Reference Emitter waveform shown in Figure 1 is an actual RE waveform taken with the TarGOST. Notice that the RE fluoresces in the same general intensity range as the pure NAPL, but it also (by design) reflects a high degree of scatter due to its buff gray color and lack of photon absorbing PAHs. The RE is designed to do this so that both the system's fluorescence and scatter components can be properly gauged and recorded on the same scaling of the oscilloscope. Once the RE is measured, all subsequent downhole (or laboratory) measurements can be normalized by this RE waveform, providing an apples-to-apples presentation of the data regardless of laser energy drift or other changes that would cause a difference in raw signal amplitude over time. It is useful to think of the RE waveform as the equivalent of the single-point 100ppm isobutylene calibration used for hand-held photo-ionization detectors.

To calculate the %RE, the area under the three fluorescence channels of the waveform is determined. The fluorescence area is then divided by the area under the laser scatter channel. This is called scatter correction. This is necessary because at very high concentrations the fluorescence does not continue to scale with concentration. This is due to complicated processes such as energy transfer, photon cycling, and other phenomenon that "quench" the fluorescence in high NAPL concentration soils. The uncorrected TLM curve in Figure 3 illustrates the problem. The addition of more and more NAPL to a soil sample should result in increasing fluorescence, but for some reason it only increase up to a certain point, at which the fluorescence response flattens out, or even worse, begins to fall. This poor type of response is called non-monotonic behavior and is obviously undesirable behavior for a screening tool. The laser scatter correction system is designed to prevent this "roll-over" affect. The scatter correction keeps this from occurring at the high end of concentrations (where soil is heavily contaminated or even saturated with NAPL). The scatter-corrected curves in Figure 3 illustrate the desired effect of scatter correction.

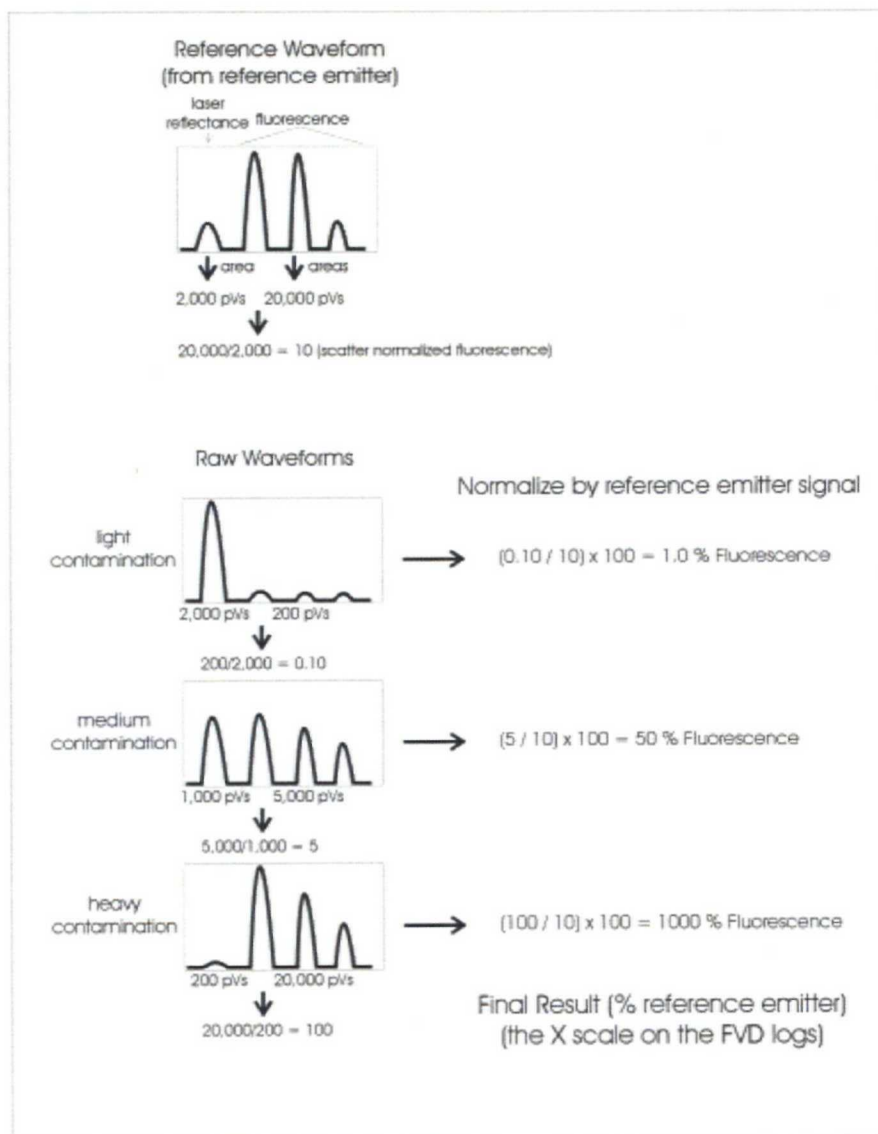


Figure 2. Single point RE calibration made prior to each TarGOST log.

The laser scatter intensity is relatively unaffected until NAPL concentrations reach the tens or hundreds of thousands PPM level, where the quenching (non-linearity of fluorescence response) is most pronounced. Laser scatter correction generally doesn't "kick in" until high concentrations are being measured, where fluorescence response flattens out or rolls over. In this way, the scatter corrected fluorescence readings scale relatively well across a wide range of concentrations, from the typical limit of detection (LOD) of 250-500 ppm, to the almost neat NAPL encountered in soil saturated with free product. Remember that TarGOST is designed to respond only to the NAPL impacted soils, not the PAHs attached in "dry" form to soot or dissolved phase PAHs. This makes it ideal for delineating source term areas of mobile MGP NAPL.

The scatter correction works well, but it isn't perfect. The TarGOST system is not an analytical instrument like a laboratory GC that sits in a clean, stable environment and only gets fed ultra-

clean matrix-isolated analytes. Instead, it is asked to respond faithfully to an analyte that exists in a thousand different forms in an endless number of different environments. Variation in optical

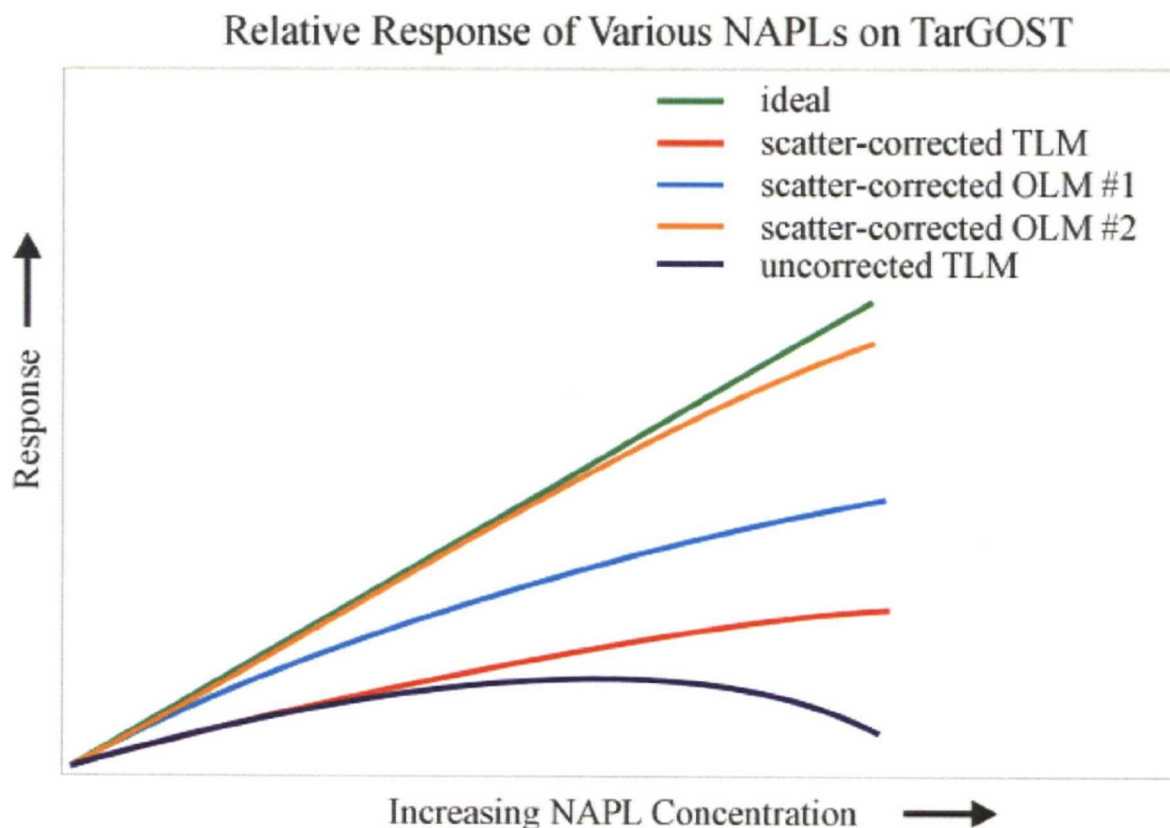


Figure 3. Variability of TarGOST response to NAPL products.

design (CPT vs. Geoprobe), mirror angle, and spectrometer settings can vary the amount of scatter present, especially at very high NAPL concentrations when the scatter is getting weak and difficult to measure relative to the much more intense fluorescence.

At high NAPL concentrations, even small variations in the laser scatter greatly influences the %RE number, especially when the laser scatter gets close to zero. For instance, let's imagine that with neat NAPL in front of the window, the fluorescence channels are averaging around 10,000 pico-Volt seconds (pVs) in area with each pulse of the laser. The laser scatter may be dancing around 400 and 800 pVs, because the scattered light is dim from being absorbed so highly by the PAHs. Now, even if the fluorescence stays almost exactly at 10,000 pVs every measurement, the relatively large variation in the tiny laser scatter that occurs will create a two or three-fold increase/decrease in %RE, even with the same NAPL sitting dead still on the window. That's why very high readings (500-1500%) often look unstable and jagged – because the laser scatter signal is so weak it “jitters” a lot compared to the fluorescence, causing large variations in %RE, even though the fluorescence portion of the waveform is relatively stable. For this reason, any wide swings in signals over 500% should “be taken with a grain of salt”.

The TarGOST operators do their best to adjust the amount of launched laser light, the spectrometer position, and mirror angle in the probe to achieve a consistent waveform for the RE at each job site and strives to maintain the same optical arrangement and a consistent RE signal for the entire project. Even though there are small differences in the setup from location to location, the variations in NAPL viscosity, soil matrix, and signal magnitude can swing the signal up or down by a factor of two or three, which dwarfs the calibration differences.

The limitations in the current calibration technique can lead to the case of significant differences in the maximum signal generated by the same NAPL from one platform to another. For instance, even if the technician adjusts the system to achieve the exact same signal with RE on both a CPT and a Geoprobe platform, the same NAPL may yield 500% on one of the platforms and 1000% on the other. This is not typical but it can and does happen for reasons that aren't fully understood. Our goal is to stay consistent at a particular site so that the entire data set from that site can be viewed consistently. TarGOST data is relatively consistent and semi-quantitative across all the data generated **at one site and for a particular NAPL product**, but significant cross-platform or lab-to-field variations can and have taken place. While this may alarm users, and we're not happy with it, it's not as serious as it seems. As an example, let us imagine a site that is contaminated with a single origin homogeneous NAPL product. With TarGOST, 100% response does indeed represent approximately twice as much NAPL as a 50% response at that site. Even if the laser energy or optics alignments change, the RE will do a reasonable job of normalizing the log-to-log data variation for that site. Dakota is currently working on an improved system that will better normalize across all systems/platforms regardless of design or conditions.

Lab studies with MGP NAPL on moist Fisher[®] sea sand consistently demonstrate that TarGOST is capable of linear response vs. NAPL concentration, but some NAPLS are better behaved than others. Figure 4 is one example of the TarGOST response vs. MGP NAPL concentration on sand.

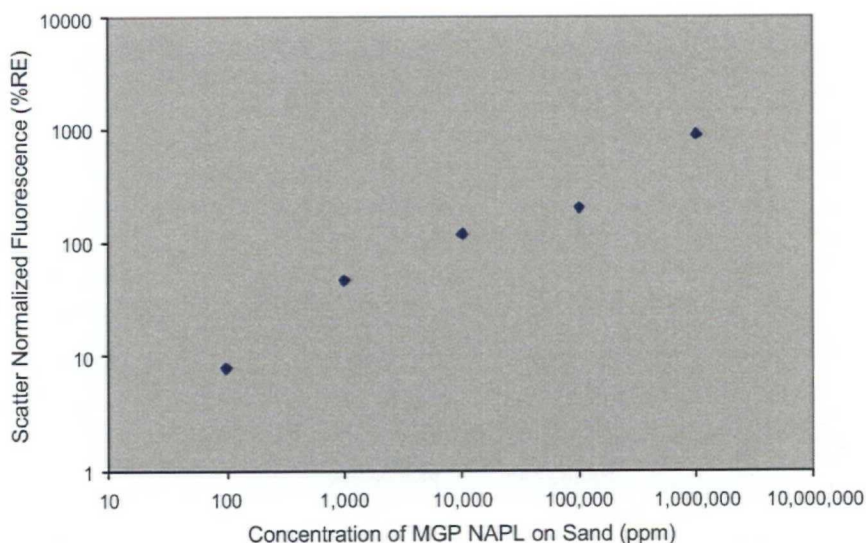


Figure 4. Calibration curve for MGP NAPL on Fisher Sea Sand

NAPLs do vary in their ability to fluoresce, even NAPLs found at the same site. Figure 3 illustrates conceptually that TarGOST often responds with varying sensitivity ($\Delta\text{TarGOST Signal}/\Delta\text{NAPL Concentration}$) toward different NAPLs, depending on their origin and/or variances in the conditions under which they've been exposed in the decades they've spent in the subsurface. For instance, a more asphaltine TLM will typically fluoresce much less intensely than a runny, less viscous OLM. This may well be due to the relative abundance of solvent in one matrix vs. the other. The more solvent available (i.e. the less viscous the NAPL), the higher the likelihood of the PAHs being able to emit photons (fluoresce) before a non-radiative mechanism allows the PAH to come back down to the ground state without emitting a photon (quenching).

The preferential sensitivity of TarGOST toward the runnier (more mobile) OLMs is welcomed by most users, since TarGOST seems to accentuate the presence of the more mobile NAPLs. It is these more mobile NAPLs that are of the highest regulatory/compliance concern. There is an abundance of anecdotal evidence that suggests that some NAPLs may fractionate in the subsurface into OLM and TLM or even DNAPL and LNAPL. Dakota has participated in a number of investigations where a single NAPL body seems to have 'split' into two distinct NAPLS, with both NAPLs having similar but distinct waveform shapes as we moved away from the suspected release point and they appear to form two separate horizons (a "high" and "low" layer). Although there has been plenty of speculation, the exact mechanism for this phenomenon (if it actually occurs) is not known.

As previously described, TarGOST uses a green laser to excite the larger (4 -5 rings and higher) PAHs that exist almost exclusively in NAPL form, as opposed to smaller (2-3 ring) PAHs that can more readily partition into the groundwater due to their much higher solubilities in water. ROST on the other hand employs ultra-violet (UV) light which can and does excite the smaller 2-3 ring aqueous phase PAHs and therefore detects dissolved phase PAHs such as naphthalenes in the groundwater. When this behavior is combined with ROST's non-monotonic response for many NAPLs, extremely complicated logs are generated that need to be computer analyzed to separate the NAPL fluorescence contribution from that of the dissolved phase. The dissolved phase signals can even surpass NAPL signals, making confident NAPL delineation almost impossible at many sites. This is especially true for those sites with sand/gravel, where pockets of NAPL are perched in or amongst slow-moving or stagnant groundwater.

It should also be mentioned that TarGOST was designed to exclusively detect heavy PAH NAPLs. It has, by design, a very limited, if any, response to lighter POLs. For instance, fresh diesel applied to the window will not elicit even a small response from the TarGOST. However, if the diesel has co-mingled with coal tar, the mixture will fluoresce brightly and TarGOST will respond well.

To better appreciate the qualitative information that TarGOST provides, the FVD logs are color-coded by "filling in" the FVD's x-axis (%RE) with colors generated from the waveform at each and every depth. The color is determined by "mixing" the amount of red, green, and blue (RGB) channels and applying the resulting color to the area under the curve on the FVD. This makes the interpretation of the logs easier to see "at-a-glance" as opposed to relying solely on the few selected waveforms to understand the qualitative nature of the data vs. depth. Color-coding alerts the observer to shifts in NAPL types and can also help identify weak interfering

compounds like calcium rich (crushed limestone) soils and rotting wood/vegetation, both of which can sometimes (rarely) be mistaken for MGP waste.

Figure 5 shows the resulting colors for differing amounts of signal in each channel of the waveforms. Clean soil shows up blue (nearly 100% laser scatter), low-to-medium contamination often shows up orange or maroon (mostly red with some blue and green), and highly contaminated soils or neat NAPL typically shows up yellow (nearly all red and green with very little blue makes yellow). The color is simply another way of representing the information contained in the associated waveforms (shown in sub-panels at right in the figure). Just think of the color-coding as mixing paints in amounts equal to that contained under each associated red, green, and blue channel of the waveform. The standard for TarGOST is to use blue, red, and green in channels 1, 2, and 3 - leaving the fourth channel unused. The fourth channel was chosen to be the non-contributor to the color scheme because it varies the least in intensity across differing classes of NAPL.

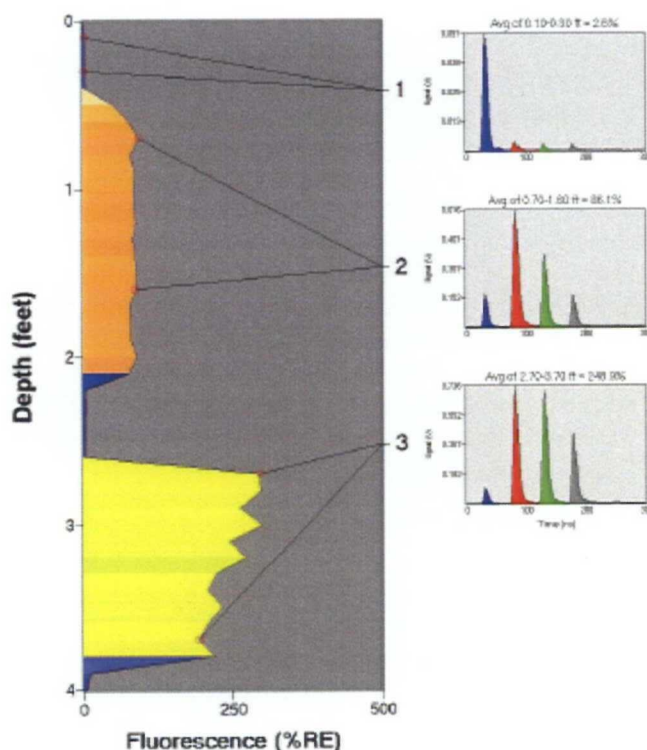


Figure 5. Example waveforms showing colors generated from RGB channel ratios.

The list below summarizes some of what we've learned in this section.

- TarGOST specifically targets the PAHs found in former MGP and creosote NAPLs
- TarGOST does detect staining and residual levels of NAPL as well as free phase
- TarGOST is "blind" to aqueous phase PAHs
- TarGOST is not able to reliably detect "dry" PAHs that are sorbed to soot, wood chips, and ash. They can generate a signal but it is often weak and not easily teased out of the background. Many times we're left wondering whether a small signal is caused by very

high concentrations of “dry” PAHs on purifier chips or ash/soot or very low (100s of ppm) residual NAPL levels.

- TarGOST’s typical lab-determined LOD for NAPL on site soil (or Fisher sea sand) is 250-500 ppm (weight of NAPL/weight of soil matrix). Note that this is not the same as weight of Total PAHs /weight of soil matrix, since not all of a NPAL is PAHs
- TarGOST has, on rare occasions, responded to mineral or plant interference enough to be a nuisance. One incident involved crushed limestone gravel fill while another involved buried rotting wood/brush debris (the result of major flooding on a gravelly river)
- TarGOST has not been observed to significantly respond to peat material (but this does not guarantee it won’t on some future occasion)
- TarGOST does not respond to typical lighter end fuels like gasoline, kerosene, or diesel – unless they contain MGP waste or creosote that they are co-mingled with
- TarGOST is single-point calibrated with a reference emitter (RE) immediately prior to each sounding and the results are always plotted relative to RE in percent
- TarGOST calibration/setup isn’t perfect and the response for an identical NAPL can vary with optical platform (CPT vs. Geoprobe) and from lab to field. However, once set up on site, the response remains stable over time and from log-to-log.
- NAPLs can vary greatly in their fluorescence response – even those found on the same site.
- Thinner, less viscous NPALS typically fluoresce much more than the more viscous TLMS. Asphalt-like TLMS which are solid/plastic fluoresce very poorly.
- Scatter-correction is applied to TarGOST data to reduce/eliminate “response rollover” at high concentrations
- Color-coding is deduced from the first 3 waveform channel areas and provides “at-a-glance” recognition of waveform consistency or changes
- The waveforms contain both quantitative and qualitative information

On-site TarGOST Fundamentals

So now that we understand the fundamentals of how TarGOST works, let’s examine the logging procedure at the site. When the system first arrives on site, it is powered up and tested for proper function. If it is in Dakota’s Geoprobe, the TarGOST is simply powered up and we’re ready to begin probing after proper warm-up. If CPT deployment is involved, the TarGOST system is integrated into the CPT truck and proper data flow connections are made (about a 2 hour procedure). Once the system is warmed up and tested for proper function, the actual logging can begin.

The delivery platform (CPT, Geoprobe truck, or track-rig) is positioned over the flag/mark as directed by the controlling geologist/consultant. Clients typically start out in an area where NAPL is known to (or strongly believed to) exist. Pushing in “the heart” of the source term at the start gives everyone involved a feel for how well the NAPL is going to respond to TarGOST delineation. From there, the effort often moves out and away from the “hot zone” toward the edges, with hopes of bounding the extent of the NAPL source term.

TarGOST productivity can range anywhere from 200 to over 500 ft/day. If the pushes are fairly deep (>30 ft), and the obstructions or rubble are minimal, then the average is on the higher end

because we spend a lot more time actually probing, not moving around from location to location and/or trying multiple times to get holes started through rubble. On jobs with lots of shallow holes and/or numerous subsurface obstructions, like brick/rubble from previous demolitions, the production obviously slows down. This is due to spending lots of time making attempts to “get a straight hole going” or from break-offs and the subsequent repair they entail. We typically can achieve between 10 and 20 locations a day, again depending on the site conditions.

Buried utility clearance is often an overlooked issue, until the first day of the project when everyone realizes we can't probe without it. Weeks or months of planning are often stalled the first day due to improper preparations with regard to utility clearance. The TarGOST crew has been instructed NOT TO PROCEED if there is even a remote chance that the proper precautions have not been made to clear the location for underground utilities.

Once the location has been cleared for utilities, the RE material is put on the cleaned window, any necessary tweaks are made to the TarGOST, and an RE waveform is acquired. The probe is then positioned in the push platform for advancement into the soil. In the case of percussion or “jack-hammering” delivery such as Dakota's Geoprobe, the window is approximately 8 inches above the tip of the probe. In the case of cone-penetrometer test (CPT) delivery, the window is approximately 16 inches above the tip of the probe. When using Geoprobe delivery, the log is initiated when the window is at the ground surface. In CPT delivery, the log is initialized when the CPT tip is in contact with the ground. In both cases, the software automatically corrects for the window position and all logs are depth correct.

A unique name for the current log location is entered into the control computer and logging is started (probe advance begins). As the probe is pushed into the ground (at ~2cm/sec) the laser fires continuously, generating waveform after waveform on the detection system oscilloscope as the probe advances. We don't store every waveform that the oscilloscope records. We instead average the waveforms over every 1-2 inches, depending on the probe speed and laser repetition rate. The averaged waveforms are downloaded from the oscilloscope every second or two by the control software. These waveforms are immediately ‘tagged’ with the current depth, which is constantly being sent to the TarGOST system by depth monitoring systems built into the Geoprobe or CPT truck. All the averaged waveforms from the logging event are stored to the hard-drive for later viewing and presentation if necessary or desired. The scatter and fluorescence areas are calculated and these are normalized to the RE waveform's areas. The fluorescence response is plotted vs. depth in real time as the probe is advanced. Logging continues until “refusal” is met due to bedrock or very tight sands/gravels, or the client wishes to terminate.

The technician then uses the TarGOST software to highlight the waveforms at “depths of interest” for display in the print out. The waveforms are located in panel plots at the right of the FVD log to guide the viewer's interpretation of the log. These waveforms contain the qualitative information and are often chosen from depths with peak signal, signal changes, or other zones of interest along the log's Y depth axis. The technician immediately prints a hard copy, which is usually printed out before the probe is completely retrieved from the subsurface. The technician also saves an electronic image of the printed log in JPG format. At the end of the project the

technician typically writes all the data and image logs to a CD, which is given to the lead geologist before departure.

Once the rods are all up and out of the hole, the hole is grouted (if necessary) and the probe tip and sapphire window is wiped clean in preparation for the next RE calibration. Time and money can often be saved by hiring a second crew/rig to grout the holes, instead of relying on the more expensive TarGOST system to do an otherwise routine task such as grouting. The next location is chosen and the procedure is repeated. The site investigation is often started with a grid or transect in mind, but it is common for the controlling geologist to modify the initially proposed investigation plan due to unforeseen “dirty” or “clean” zones encountered during the project. It is actually rare for the original transect or grid pattern to remain unchanged during the entire investigation, since the TarGOST regularly reveals previously unknown conditions at the site, including NAPL-free areas where significant NAPL was expected.

We recommend that the client conduct validation/confirmation sampling to bolster confidence in the body of evidence generated with TarGOST. Validation sampling of 10% of the TarGOST locations seems to be the most common co-sampling effort. Once the client gets familiar with TarGOST and becomes more comfortable with interpreting the results, they typically only sample where results are confusing or fly in the face of previous site understanding/information.

It is recommended that the client also conduct a few side-by-side tests of TarGOST for site heterogeneity assessment. Some sites yield nearly identical TarGOST logs when they are conducted a few feet apart because the NAPL is lying in well-behaved, homogeneously distributed layers. Other sites have extremely complex and heterogeneous NAPL distribution and yield side-by-side TarGOST logs with significant differences. In these conditions it is certainly unfair to conduct co-sampling efforts for TarGOST validation and expect TarGOST to “match” the traditional sampling results. In this case, even though the NAPL is scattered here and there, the validation hole is considered to be “right” and the TarGOST log, if not matching, is considered “wrong”. In such heterogeneous environments even two side-by-side traditional sampling efforts might not come close to matching each other. So which one of the two traditional sampling locations is “right” and which one is “wrong” in this instance? Clearly neither is right or wrong, the site NAPL is simply heterogeneously distributed. Please keep this in mind when validation sampling against TarGOST as well.

The list below summarizes key aspects of deploying TarGOST at a former MGP or creosote site.

- TarGOST production averages between 10 and 20 locations/day and 200-500 ft/day, depending to large degree on subsurface conditions and difficulty in positioning the push platform over the desired location
- Proper utility clearance is the most important step in assuring a timely start and to prevent delays
- Start pushing in the “heart” of the source term to get a feel for the responsiveness of the TarGOST to your particular site’s NAPL, then work your way out to find the edges and bound the source term NAPL
- Be prepared to adapt your transect and grid to ever-changing site model as TarGOST logs are reviewed

- On large-scale projects, consider hiring a second crew to pre-probe and/or grout with a small Geoprobe or drill rig if regulations/conditions warrant. While we don't mind doing the pre-probing or grouting ourselves, we want to spend the majority of our time doing what it is we're getting paid to do – delineate the site's NAPL
- Can TarGOST tell the difference between residual and free phase NAPL? The answer is clearly "No". There is no exact concentration where all NAPLs make a magical transition from "heavy residual" to "saturated or free-phase". Likewise, there is no set %RE that we can cite as being representative of saturated or free phase NAPL, since the response is continuous with concentration. With that said, it is certainly possible to determine a certain cutoff or signal range that is representative of the residual to free-phase transition for your site. For instance, let's say that after examining all the TarGOST logs and comparing them to previous efforts and the validation sampling, the geologist notes that free phase existed at depths/locations where the TarGOST logs exceeded 50%. It's certainly reasonable then to make the assertion that the 50% RE level is a general cutoff for the absence/presence of free-phase. Just remember that the entire body of evidence for any particular site should be used to come up with your %RE number

If you have any questions regarding your past or future project, feel free to call or write to your TarGOST operator or Randy St. Germain at stgermain@dakotatechnologies.com.

Attachment B
Quanta TarGOST Evaluation

TarGOST Fluorescence Response Data

Site: Quanta

Client: CH2MHILL

Date/Time: 4/4/2006 @ 8:40:23 AM

OST Unit: DT102

Latitude: Unavailable

Operator: T. Rudolph

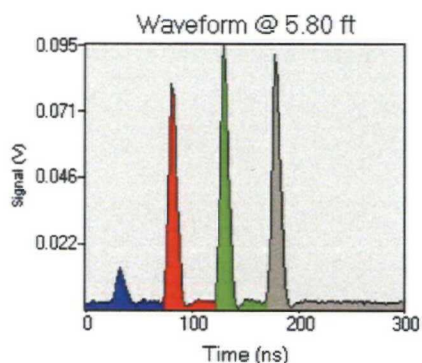
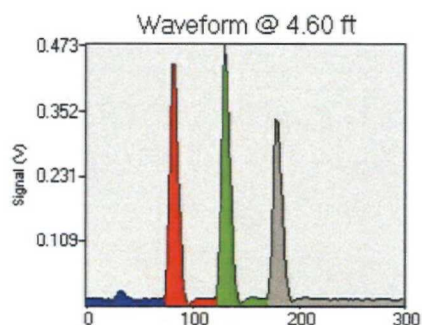
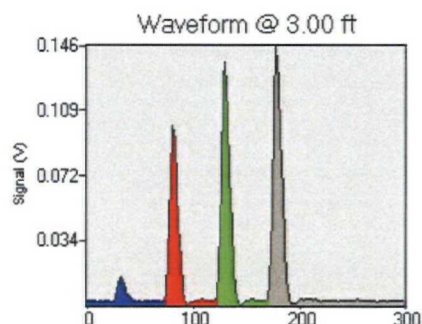
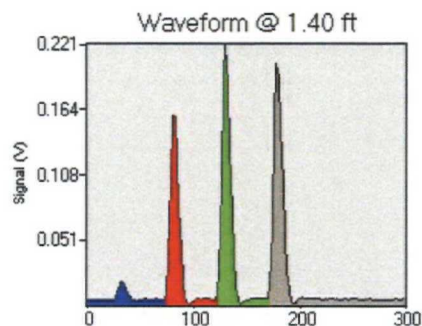
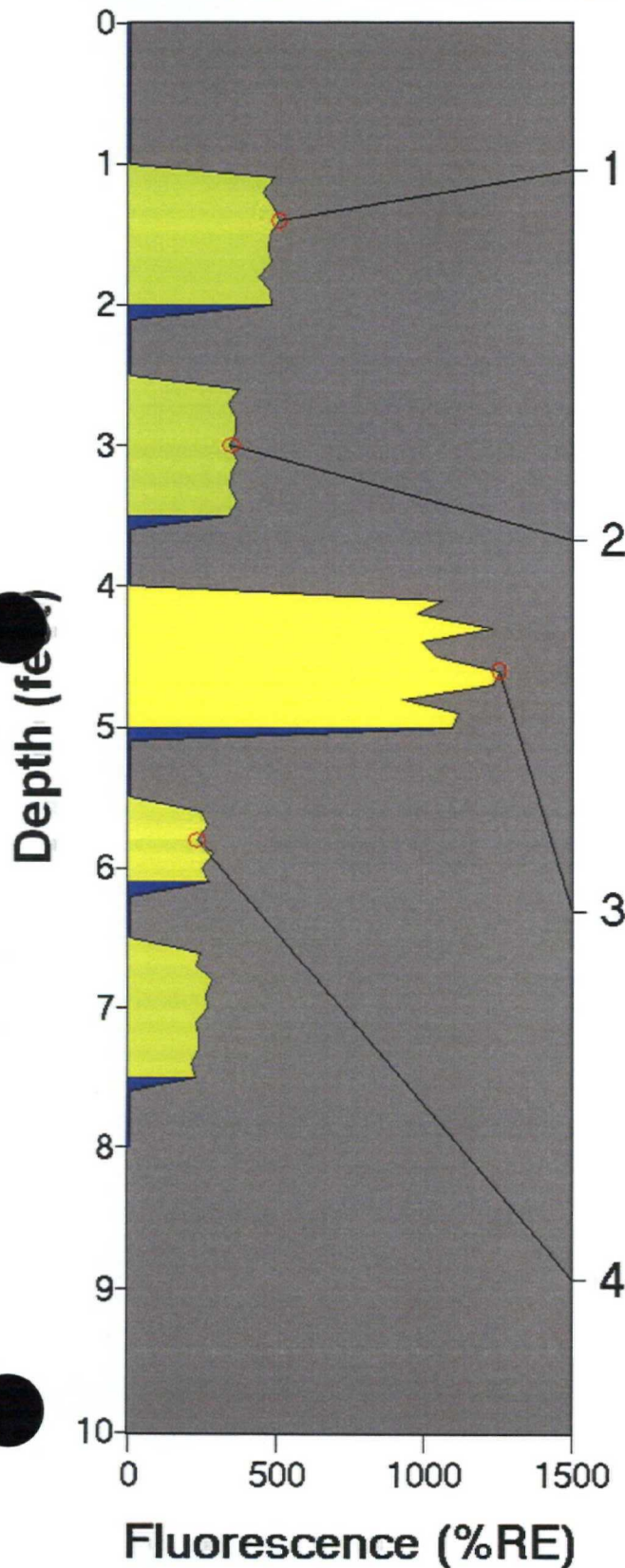
Job #: 001

Max fluorescence: 1252.68% @ 4.60 ft

Final depth BGS: 8.00 ft

Longitude: Unavailable

Quanta Site TarGOST01



Fluorescence (%RE)

UVOST Fluorescence Response Profile

Site: Quanta

Client: CH2MHILL

Date/Time: 3/31/2006 @ 8:54:34 AM

OST Unit: 01

Latitude:

Operator: T. Rudolph

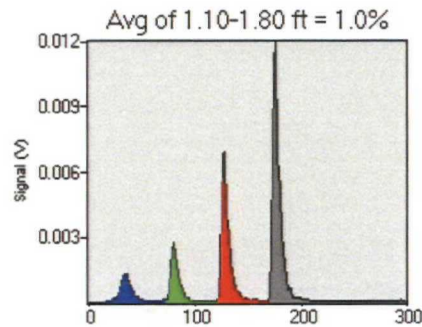
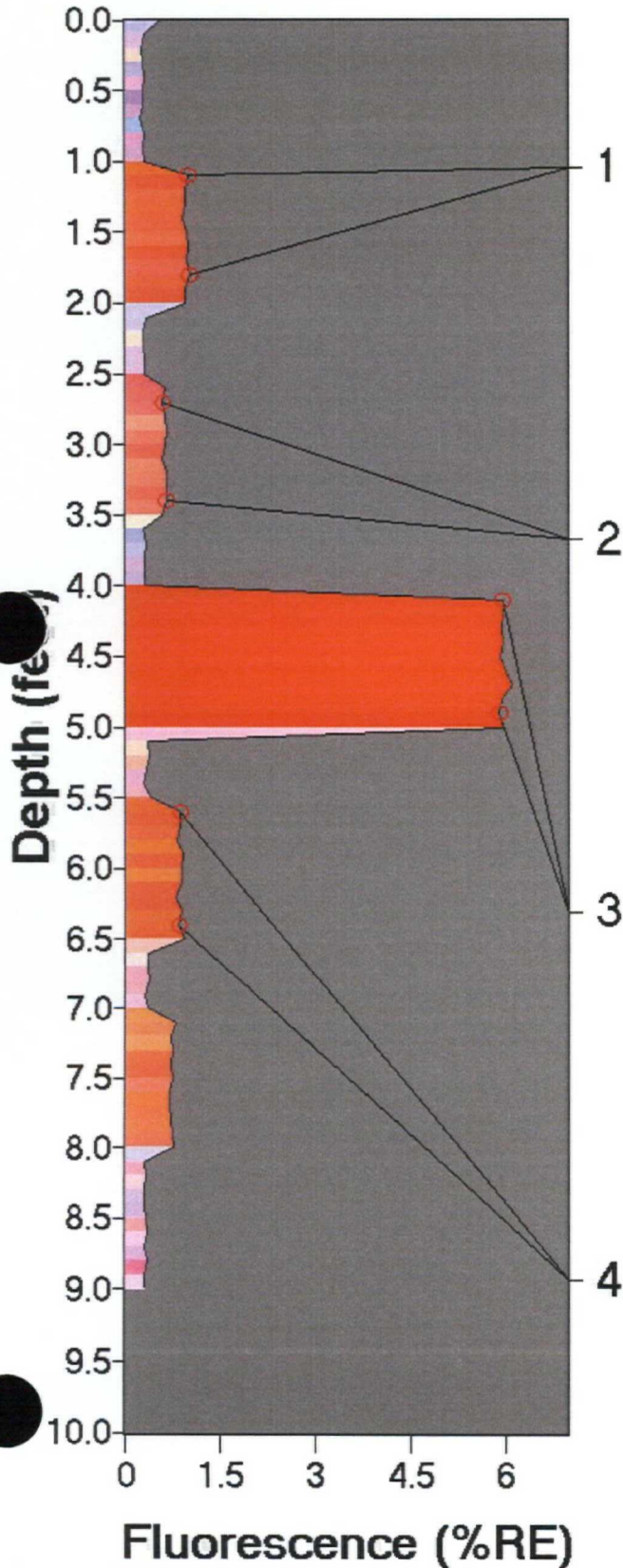
Job #: 001

Max fluorescence: 6.09% @ 4.70 ft

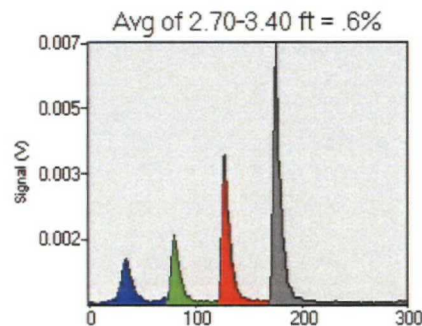
Final depth BGS: 9.00 ft

Longitude:

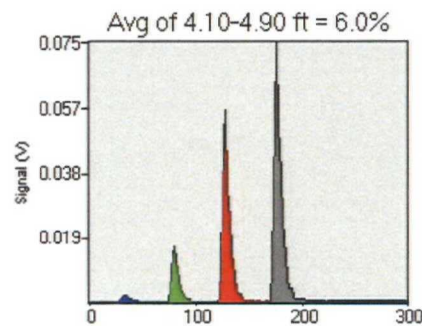
Quanta Site UVOST1



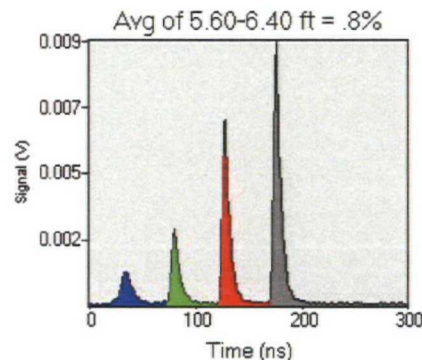
MW-102



MW-105



MW-107



MW-112

Attachment C
Vibracore Sediment Sampling SOP

Vibracore Sediment Sampling

Purpose

This technical practice describes the collection and handling of surface and subsurface sediment samples during field operations.

Scope and Applicability

This sediment sampling technical practice is applicable to collecting representative sediment samples using a Vibracore sampler.

Refer to the specific requirements of the project in the Work Plan/Sampling Plan (WP/SP) and Quality Assurance Project Plan (QAPP) when using this SOP during field activities.

Example Equipment / Materials

- Vibracore mounted on marsh equipment, barge, boat, truck, etc. (vehicle selected will be based on site conditions)
- Aluminum core barrels and Tygon® liners
- Equipment to process the sediment cores such as tools to open samplers, plastic sheeting, spatulas or knives, and tape measure
- Sample containers with Teflon®-lined caps
- Coolers with ice for sample storage
- Field data sheets, chain-of-custody forms, and related materials
- Items needed to document data collection activities and to label sample jars for shipment, including camera, film, field notebook, pens, sample labels, and custody seals
- Personal protection equipment as required by the health and safety plan
- Decontamination equipment

Vibracore Sampler

Vibracoring or vibratory coring uses a variable-speed, vibrating head mounted atop a core barrel up to 30 feet in length to obtain a virtually undisturbed core sample in sand, silt, or clay. The core barrel is lined with a sample liner that is capable of collecting continuous sediment samples up to 3 inches in diameter. The Vibracore sampling system can routinely collect 10- to

20-foot continuous core samples in loosely consolidated, wet, or water submerged media.

Operating Procedures / Guidelines

1. Assemble and test the vibracore according to manufacturer's instructions. Assemble the core liner, core cutter and catcher.
2. Lift the vibrahead until the core assembly is hanging under the vibrahead base. Slide the weight stand base under the vibrahead and lower the vibrahead and core tube into the guide tube of the weight stand.
3. Measure and record the length of the vibracore unit from the bottom of the core barrel to the top of the vibracore. Attach a measuring tape to top of the vibracore.
4. For submerged sediments the progress of the vibracore will be measured at the surface water/air interface, or as specified in the WP/SP. To determine the sediment/water interface ("0" feet of penetration), slowly lower the vibracore and core barrel into the water until the bottom of the core barrel is at the sediment/water interface. Measure the depth of the water. The water/air interface at 0 feet of penetration is determined by subtracting the measured length of the vibracore unit from the water depth. The final depth is determined by adding the water depth. Lower the vibracore unit until the desired depth appears on the measuring tape attached to the top of the vibracore. Record the depth that appears on the measuring tape at the surface of the water.
5. For exposed sediments, 0 feet of penetration can be determined visually when the core barrel contacts the sediments.
6. Lower the assembly at a rate not to exceed 1 ft/sec.
7. Activate vibracore and begin lowering unit to allow penetration into the sediment. Every 15 seconds record the depth that appears on the measuring tape at the surface of the water or along the side of the core barrel (this will later be converted to penetration rate). A noticeable decrease in penetration rate will indicate that the sediment clay layer has been reached. Record final penetration depth (pd) and time on vibracore sampling log.
8. Slowly winch vibracore out of sediment and up to the surface of the water. It may be necessary to activate the vibracore to withdraw the core barrel from the sediment when collecting deep samples (i.e., 15 feet or deeper.)
9. Place the core barrel on the deck of the barge or boat. Remove the cutter head and core catcher from the end of the core barrel, remove the Tygon core liner, cap and tape both ends of the core barrel, and clearly label the core with sample identification and core orientation ("surface" on one end and "clay" on the other). For continuous deep cores the core liner will be cut into five foot lengths for easier handling. Both ends will be capped and taped.
10. Maintain the sample in the vertical position until the core is delivered to the sample processing area for logging and sample processing.
11. Transport core and associated vibracore sampling log to sample processing area for logging and sampling.

12. Lay the sample tube horizontally on the sample-logging table, remove end caps, and drain excess water.
13. Cut the core barrel off on the end labeled "surface" just above sediment and then replace the cap.
14. Measure the length of the core sample collected and record as "core recovery" (cr) on the vibracore sampling log.
15. Cut the tube lengthwise with a power shear; two lengthwise cuts roughly 3 inches apart will be made and a 3-inch-wide strip of the tube removed.
16. Cut away the smeared edge of the sample core with a clean putty knife.
17. Log and photograph the core and record the data on a standard log sheet or logbook.

Sampling Procedures / Guidelines

1. Make a sketch of the sample area, showing nearby features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (e.g., along shore, mid-channel).
2. Start downstream and work upstream to prevent contamination of unsampled areas.
3. Collect the sediment sample. Refer to the WP/SP for specific sample handling requirements.
4. Ensure that all field observations are recorded completely and correctly. After the sample is judged acceptable, the following observations shall be recorded:
 - Station location indicated on the GPS instrument
 - Station depth
 - Gross characteristics of the surficial sediment
 - Texture
 - Color
 - Biological structures (e.g., shells, tubes, macrophytes)
 - Presence of debris (e.g., wood chips, wood fibers, human artifacts)
 - Presence of oily sheen
 - Odor (e.g., hydrogen sulfide, oil, creosote)
 - Gross characteristics of the vertical profile

- Changes in sediment characteristics
 - Presence and depth of redox potential discontinuity (rpd) layer
 - Penetration depth using a stainless steel ruler at the center of the sampler
 - Comments related to sample quality/integrity:
 - Leakage
 - Winnowing
 - Disturbance
5. Sediment core samples shall be processed as soon as possible after sampling. If cores cannot be processed immediately after sampling, they shall be frozen within the core tube. To process the core, insert the decontaminated piston into the top of the core tube and extrude the core sample from the tube bottom. Specific section lengths can be cut and processed for chemical, biological, or toxicological analysis. Sections shall be placed in appropriate sample containers as specified in the WP/SP and QAPP.
 6. Transfer sample into sample jars using a decontaminated stainless steel spoon or utensil. Never touch the sediment sample because gloves may introduce organic contamination into the sample. Samples that are to be analyzed for trace metals need to avoid sample contamination during collection. All sampling equipment (i.e., siphon hoses, scoops, containers) shall be made of non-contaminating material (i.e. Teflon coated or stainless steel) and shall be cleaned appropriately before use and between sampling efforts. Disposable sampling gloves shall be worn while handling samples and disposed of between samples. In addition, potential airborne contamination (e.g., stack gases, cigarette smoke) shall be avoided. No sediment that is in contact with the sides of the sampler shall be used.
 7. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

Calculate Sediment Compression

Core samples may expand or compress during coring and transport. The amount of compression or expansion must be accounted for when separating longitudinal sample sections of the core (i.e., "1-foot sections"). The amount of compression or expansion can be calculated using the cr and pd values. Because the clay layer sampled should not appreciably compress or expand, the amount of clay layer recovered (cl) may not need to be included in this calculation. The percentage of core compression or expansion can be calculated as follows:

$$(cr-cl) / (pd-cl) \times 100 = \text{percent expansion or compression}$$

Example solution, where:

Final penetration depth (pd) = 15 ft

Clay recovery (cr) = 12 ft

Measured length of recovered clay (cl) = 3 ft

$$(cr-cl) / (pd-cl) \times 100$$

$$(12-3) / (15-3) \times 100 = 75 \text{ percent compression}$$

Therefore, each 1-ft section of the core, excluding clay, has theoretically been compressed to 75 percent of its length. A representative 1-ft section of the core would be 75 percent of 12 in., or 9 in.

Sample Sediment

- Based on the above calculation of core compression or expansion, separate the core into the appropriate strata and collect samples using a Teflon® spatula. Collect samples from the center of the core and handle samples as described in the WP/SP to create one representative sample of each desired strata.
- Place each sample into the appropriate pre-labeled sample container as specified in the WP/SP and QAPP.
- Collect the appropriate QA/QC samples.
- Decontaminate all downhole boring equipment between boring locations.

Key Checks/Items

- Stabilize and secure sampling platform at correct location.
- Check assembly and operation of vibracore before deployment.
- Cap and label core tube as soon as possible.
- Keep complete field notes.
- Work safely.

Appendix B

Quality Assurance Project Plan, Operable Unit 2 Quanta Resources Site Edgewater, New Jersey

Prepared for
Honeywell International, Inc.

101 Columbia Road
P.O. Box 2105
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August 2006

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Reviewed and Approved By:

Project Manager:



Date: 8/10/2006

QA Manager:



Date: 8/10/2006

Distribution List

In accordance with the Administrative Order on Consent (AOC) for OU2, all work plans, reports, notices, and other documents will be submitted via certified mail return receipt requested, or overnight mail to the following addressees:

Number of Copies	To
7 (Including 1 unbound copy)	ATTN: Quanta Resources Site Remedial Project Manager New Jersey Remediation Branch Emergency and Remedial Response Division U.S. Environmental Protection Agency, Region II 290 Broadway, 19 th Floor New York, New York 10007-1866
1	ATTN: Quanta Resources Site Attorney New Jersey Superfund Branch Office of Regional Counsel U.S. Environmental Protection Agency, Region II 290 Broadway, 17 th Floor New York, New York 10007-1866
4	ATTN: Quanta Site Manager Bureau of Federal Case Management New Jersey Department of Environmental Protection 401 East State Street P.O. Box 028 Trenton, New Jersey 08625-0028
4	Tim Metcalf Honeywell International, Inc. 101 Columbia Road, MEY-3 Morristown, New Jersey 07962
2	Andy Hopton CH2M HILL 1700 Market Street, Suite 1600 Philadelphia, PA 19103

Honeywell reserves the right to send one copy of each such document to each of the listed recipients and post each document on a website maintained by Honeywell and accessible to all recipients listed above, in accordance with the AOC.

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SECTION 1

Project Management Elements

1.1 Project/Task Organization

The organization and responsibilities of the project team are described in detail in Section 4 of the Remedial Investigation / Feasibility Study (RI/FS) Work Plan. It should be noted that the Quality Manager (QM) is independent of those collecting project information. The RI/FS Task Manager will be responsible for maintaining the official Quality Assurance Project Plan (QAPP). Figure 1-1 and the table below lists the individuals involved with major aspects of this project.

Name	Organization	Role
Richard Ho	EPA	EPA Remedial Project Manager
Robert Hayton	NJDEP	NJDEP Remedial Project Manager
Tim Metcalf	Honeywell International	Respondent's primary contact for the site
Steve Zarlinski	CH2M HILL	Project Manager
Bill Berlett	CH2M HILL	Health and Safety Manager
Scott Saroff	CH2M HILL	Senior Consultant and Project Quality Manager
Scott Stoldt	CH2M HILL	OU1 RI/FS Task Lead
Andrew Hopton	CH2M HILL	OU2 RI/FS Task Lead and Ecological Risk Assessor
Austin Harclerode	CH2M HILL	Field Team Leader
Barrie Selcoe	CH2M HILL	Human Health Risk Assessor

1.2 Problem Definition/Background

The Quanta Resources Corporation Superfund Site consists of the Quanta Resources property located at 163 River Road and other neighboring properties where contamination¹ from the property may have migrated². The Quanta Resources property covers approximately 15 acres and was bisected in 1995/1996 by the realignment of River Road,

¹ Contamination shall be considered to mean the presence of constituents of concern (COCs) related to former coal tar or waste oil industrial operations on the property, or allegedly emanating from the property.

² As defined in the Administrative Order on Consent (AOC) II-CERCLA-2003-2012, the Quanta Resources Superfund Site includes the former Quanta Resources property, located on River Road in Edgewater, New Jersey, and any areas where contamination from the property has come to be located. The current extent of the Quanta Resources property (referred to herein as the "Quanta Resources property") refers to Block 95, Lot 1 as defined on the Borough of Edgewater, New Jersey tax map.

which now runs north-south through the western portion of OU1. Surface water and sediment in the Hudson River adjacent to the Site make up OU2. Surrounding Property Descriptions

1.2.1 Edgewater Enterprises and Lustrelon

The properties immediately surrounding the Site are zoned for mixed industrial, commercial, and residential uses. The Quanta Resources property is bordered on the north by the Edgewater Enterprises and Lustrelon properties (Figure 1-2). Both are undergoing redevelopment with commercial and residential structures. The Quanta Resources property is bordered to the north by the Promenade at City Place development on the Edgewater Enterprises property (the former Celotex Industrial Park). The Promenade at City Place complex contains a mixture of residential and commercial properties with several retailers at ground level, residential units (both owner occupied and rentals) above, and a 122-room hotel. Construction is underway for a mid-rise apartment building and a series of townhouses.

1.2.2 115 River Road, LLC and Lever Brothers

Bordering the Quanta Resources property to the south is the 115 River Road, LLC office complex. The property currently includes parking, offices, a bank, and a day-care center. South of the 115 River Road, LLC property is the Lever Brothers property, formerly occupied by Unilever Research. The Lever Brothers property is bordered on the east by the Hudson River and on the west by Old River Road (Figure 1-2).

1.2.3 Block 93, Lots 1, 2, and 3

Three lots on Block 93 (Lots 1, 2, and 3) are located between Old River Road and River Road, although only Lot 3 is believed to have been part of the former Quanta Resources operations. The Three Y, LLC property consists of Lots 1 and 2. Lot 2 is a former railroad right-of-way that is partially paved. There is a solid waste dumpster, old vehicles, portions of a chain-link fence, and remnants of railroad track on Lot 2. A partially paved parking area and two-story restaurant are located in the southwest corner of Lot 1. Remnants of a building foundation, construction vehicles, and old vehicles are located near the southeast corner of the lot. The remainder of the lot consists of a grassy area with an old food concession (O'Brien & Gere, 2004).

The main objective of the field sampling is to define and assess the physical and chemical conditions at the site and their possible impacts and risks to human health and the environment. In particular, the specific objectives of the RI/FS, as described in the Work Plan are:

- Characterize potential sediment and surface water impacts associated with the former coal tar distillation plant and the former oil recycling facilities.
- Define the nature and extent of site related chemical constituents, and delineate those impacts caused by the release of chemicals to the surface water and sediments.

- Evaluate the potential risks to human health and the environment associated with the presence of chemicals at the Site associated with the operation of the former coal tar distillation plant and the former oil recycling facilities.
- Develop supplemental data sufficient to address data gaps associated with previous investigations to refine the conceptual site model (CSM) and to determine the need for, and to conduct an evaluation of, appropriate remedial alternatives.

1.3 Project/Task Description

The RI/FS for the OU2 Site will supplement data collected during previous investigations at the site. The RI/FS will be completed in accordance with the schedule presented in the Work Plan. As part of the RI/FS, the following field investigations and tasks will be performed:

- Collect surface water and sediment samples to characterize nature and extent of contamination at the site.
- Perform laboratory analysis of samples.
- Perform instrument survey.
- Perform data validation, review, and interpretation.
- Perform human health and ecological risk assessments.

All field activities, including a schedule, maps, and tables are discussed in detail in the Field Sampling Plan (FSP) and the Work Plan for this Site. Reports will be issued in accordance with the Work Plan and the Statement of Work for the Site.

1.4 Quality Objectives and Criteria

The purpose of the QAPP is to present the quality assurance/quality control (QA/QC) procedures and to set forth the analytical methods and procedures to be implemented during the RI/FS. The QAPP has been developed to provide data quality that is sufficient to meet the RI/FS objectives.

The data produced during the RI/FS will be compared with the defined QA objectives and criteria for precision, accuracy, representativeness, completeness, and comparability (PARCC). The primary goal of these procedures is to ensure that the data reported are representative of actual conditions at the Site.

This data assessment activity is an ongoing process, coordinated with data production, and is intended to assure that all data produced during the project are acceptable for use in subsequent evaluations. Both statistical and qualitative evaluations will be used to assess the quality of the data. The primary evaluation of the data will be based on the control samples described in Section 2.5. The blank samples will be used to evaluate whether or not the laboratory represents a possible source of sample contamination, and duplicate sample results will be used to evaluate data precision.

1.4.1 Data Quality Objectives

Data Quality Objectives (DQOs) were developed for this RI/FS WP following the most recent EPA guidance (EPA, 2006). The seven steps of the DQO process for the overall RI/FS WP are presented below.

Step 1. State the Problem

The Quanta Resources Site is located on the western shore of the Hudson River in Edgewater, New Jersey. Former industrial properties border the site on the north and south. The site was used for coal tar refining from 1930 to 1974, and waste oil reprocessing from 1974 to 1981 (Parsons 2004). These activities led to the release of NAPL and other site-related chemicals to surface and subsurface soils, groundwater, and near-shore sediment adjacent to the site. The upland part of the site (OU1) is backfilled with 10 or more feet of non-native fill and has a wooden pile bulkhead along the shoreline. The offshore portion (OU2) includes intertidal and shallow subtidal sediments.

Existing data for OU2 indicate that NAPL occurs as lenses interbedded with silt, and that concentrations of PAHs in sediment are elevated in areas where NAPL is found.

Concentrations of other chemicals appear to be either generally uniformly distributed, or highest adjacent to the bulkhead. Elevated concentrations of several chemicals were also found in sediment to the north of the Quanta Resources Site, adjacent to the former Lustrelon property. The extent of NAPL in OU2 was delineated in 1999 using CPT/ROST technology. This method, while the best available technology at the time, is not capable of differentiating various types of petroleum products or providing a detailed and refined interpretation of coal tar distribution. In addition to contaminants from the Quanta Resources Site, OU2 sediments may be affected by urban runoff and upstream and/or downstream sources of contamination. An RI/FS of OU2 is required to:

- Determine the lateral and vertical distribution and extent of PCOIs associated with releases from the Quanta Resources Site;
- More accurately delineate the extent of coal tar in sediment;
- Characterize the depositional environment adjacent to the site;
- Characterize potential ecological and human health risks associated with exposure to contaminants from the site; and
- Obtain information to evaluate the most feasible options for managing sediments.

General types of data needed to proceed with the RI/FS include chemical concentrations in surface sediment, subsurface sediment, surface water, and fish and/or shellfish tissue; detailed information on the distribution of coal tar, sediment stability and deposition rate, and data for physical characteristics of sediment.

Step 2. Identify the Goals of the Study

The following are the principal study questions for the OU2 RI/FS, potential alternative actions based on the answer to the question (for decision questions), and associated decision or estimation statements. The principal questions for the BERA and the Human Health Risk Assessment (HHRA) will be presented in a separate WP.

1. **Principal question:** What PCOIs are present in OU2 sediment at concentrations exceeding regional background levels, and are related to historical activities at the Quanta Resources Site?

Alternative actions: PCOIs that exceed regional background levels, are related to historical activities at the site, and contribute to unacceptable levels of ecological or human health risk will be the focus of remedial action objectives (RAOs) for OU2. Alternatively, PCOIs that do not meet these criteria are unlikely to be the focus of RAOs.

Decision statement: Determine whether PCOIs in OU2 sediment exceed regional background levels and are related to historical activities at the Quanta Resources Site.

2. **Principal question:** What are the lateral and vertical distribution and extent of coal tar and site-related PCOIs in OU2 sediment?

Estimation statement: Information about the distribution and extent of coal tar and site-related PCOIs in sediment are needed to evaluate potential ecological and human health risks, and to define the boundaries of the area to be evaluated in the risk assessments and FS. The objective of this RI is to identify the horizontal and vertical boundaries beyond which concentrations of site-related PCOIs do not exceed background threshold values, and coal tar is not present.

3. **Principal question:** What are the characteristics of the depositional environment in OU2?

Estimation statement: Information about the depositional environment will be used to refine the conceptual site model. Sediment erosion and deposition patterns will influence the development and evaluation of remedial alternatives for OU2, including dredging, capping, and monitored natural recovery.

4. **Principal question:** What are the physical characteristics of sediment that will influence the feasibility of various sediment management approaches? (estimation problem).

Estimation statement: Physical characteristics of sediment (grain size distribution, TOC content, moisture content, bulk density, strength and consolidation characteristics, and particle settling characteristics) will influence the conceptual design of remedial alternatives for sediment.

Step 3. Identify Information Inputs

The information needed to answer the principal study questions will be obtained through new data collection and from existing information. Information inputs are as follows:

- Analytical chemistry data for sediment samples collected from OU2 and upriver and downriver locations. Detection limits for the analytical parameters identified in Step 7 must be sufficient for performing risk assessments.
- Sediment sample data from previous OU2 investigations.
- Data for regional background concentrations of PCOIs in lower Hudson River sediment from other sources (i.e., literature, regional databases), as available.

- Detailed analytical data for PAHs to support a “fingerprinting study” to differentiate PAHs originating from site-related coal tar from other sources of PAHs (e.g., urban runoff).
- TarGOST™ survey results.
- Field data, such as sample coordinates and elevations, water depth and tide height, geologic description of sediment cores, field observations of coal tar seeps.
- OU1 data and information regarding historical operations and environmental conditions.
- Radioisotope profile data (cesium-137) for sediment cores in undisturbed areas to evaluate sediment stability and identify net sediment accumulation rate.
- Scientific literature regarding hydrodynamics and sediment transport in the lower Hudson River.
- Sample data for grain size distribution, TOC, moisture content, bulk density, Atterberg limits, self weight consolidation, permeability, and column settling tests.

Step 4. Define the Boundaries of the Study

The target populations for this study are OU2 sediment that has been affected by releases from the Quanta Resources Site, and upriver and downriver sites that are not affected by measurable amounts of PCOIs from the Quanta Resources Site.

Existing sediment sample data from OU2 indicate that elevated PAH concentrations appear to be closely associated with the occurrence of NAPL. Concentrations of other PCOIs appear to be either uniformly distributed or highest adjacent to the bulkhead. Therefore, the study area will be bounded on the west by the shoreline and will extend to the east approximately 900 feet, and will extend upriver to the George Washington Bridge (approximately) and 3.5 miles downriver, approximately. An area north of the former gypsum landfill adjacent to the former Lustrelon property will also be included in the study because elevated concentrations of some PCOIs were previously measured in this area (GeoSyntec 2000).

Sediment samples should be collected at a sufficient density to map COPC concentration gradients, which are expected to be highest adjacent to the bulkhead and decrease to regional background levels with increasing distance from the shoreline. Sample density should also be sufficient to support the risk assessments and development of remedial alternatives. Evaluation of existing information on COPC concentration gradients indicates that a surface sediment sample spacing of approximately 100 to 150 feet will meet these objectives.

The vertical boundary of the study area will be 50 feet for the TarGOST™ survey, which is expected to extend beyond the extent of coal tar, with the possible exception of one location where hydrocarbons were previously detected at a depth greater than 50 feet (GeoSyntec 2000). Sediment samples will be collected to a depth of 30 feet using a Vibracore. If coal tar is detected at depths of greater than 30 feet, an attempt will be made to collect deep sediment samples with the Geoprobe rig used for the TarGOST™ survey.

Subsurface sample data should represent smaller depth intervals in shallower sediment to increase its utility for risk assessment purposes. Deeper sediments can be represented by larger intervals to provide a broad indication of the vertical extent of contamination. Therefore, subsurface samples will represent 0.5-foot intervals in the top 1 foot of sediment, a 1-foot interval from 1 to 2 feet below the mudline, and 2-foot intervals below 2 feet (sample intervals are described in more detail in Step 7).

If site-related contamination is found to extend beyond the lateral or vertical study boundaries, or if more detailed lateral or vertical characterization is needed in specific areas, the data gaps will be identified and a supplemental investigation will be implemented as needed.

Upriver and downriver locations will be collected at locations along the western shore of the river in areas that appear to be physically similar to the Site. Samples will be collected at these locations and analyzed for the same physical and chemical constituents as the Site samples. After the sampling results are received the suitability of these samples for use as possible reference samples will be evaluated based on the following criteria: 1) grain size distribution and TOC content expected to be similar to the study area; 2) salinity and hydrodynamic conditions similar to the study area; 3) habitat characteristics similar to the study area to the degree possible; and 4) based on the conceptual site model, locations expected to be representative of regional conditions in the lower Hudson River, with the exception of the absence of measurable quantities of chemicals from the Site.

Step 5. Develop the Analytic Approach

A weight-of-evidence approach will be used to identify site-related PCOLs in sediment. If multiple lines of evidence point to a similar conclusion, then the degree of confidence in the conclusion will be increased. The following lines of evidence will be considered:

- If COPC concentrations in OU2 sediment samples exceed regional background threshold values, then they may be considered site-related. The general approach for establishing background threshold values for sediment will be as follows:
 - Compile the upriver and downriver sample results and statistically evaluate the data for the presence of outliers. Remove statistical outliers from the data set. PAH fingerprinting data for upriver and downriver sediment samples also will be used to evaluate whether the location is potentially affected by PAHs from the Quanta Resources Site.
 - The background threshold values will be determined as either a specified percentile of the background distribution, or as an upper tolerance limit (UTL) of the distribution (e.g. the 95% confidence limit on the 95th percentile), depending upon the suitability of the data to support the calculation.
 - After suspect data points are removed from the data set, a one-tailed 95 percent upper prediction limit (UPL) for each chemical will be computed. The 95 percent UPL is a statistically derived confidence bound that is 95 percent certain to contain all possible background results. Background threshold values for each chemical will be the 95 percent UPL or the highest potential background value, whichever is lower.

- Calculated background threshold values will be compared with available published information about regional concentrations of PCOIs in the lower Hudson River to verify that they are reasonable estimates of regional background concentrations.
- If the PAH fingerprint in a sediment sample is indicative of a coal tar source, the PAHs may be site-related. Conversely, if the PAH fingerprint is consistent with urban runoff or other hydrocarbon sources not related to Quanta Resources Site activities, the PAHs may not be site-related.
- If PCOIs are related to historical operations at the Site and sample results are consistent with the conceptual site model for OU1, they will be considered site-related.
- If COPC concentration gradients in sediment indicate that OU1 is the source of contamination to OU2, they will be considered site-related.

TarGOST™ survey results will be used to map the horizontal and vertical extent of coal tar in OU2 sediment. OU2 sediment sample analytical data and results from previous investigations will be compared with background threshold values on a point-by-point basis and used to map the distribution and extent of PCOIs above background threshold levels. Field observations will be used to broadly define the extent of coal tar seeps.

Cesium-137 activity will be plotted with increasing depth in the sediment core from three locations away from the bulkhead and piers where sediments may be less disturbed. The first appearance of Cesium-137 will be determined to approximately represent the 1954 time horizon, when atmospheric testing of nuclear devices was initiated. The shape of the Cesium-137 profile will be used to evaluate the degree of physical mixing of the sediment column: if the profile shows a distinct subsurface peak, then the sediment column will be considered relatively stable. A disrupted or uniform activity profile will indicate a more dynamic depositional environment, or anthropogenic disruption (e.g., dredging).

Physical data for sediment samples will be used to calculate summary statistics (minimum, maximum, median, and mean). The results will be used to evaluate the potential effectiveness of various sediment management approaches for consideration in the FS.

Step 6. Specify Performance Criteria

An important objective of this investigation is to ensure that the nature and extent of contamination attributable to the Site is defined. The OU2 sediment sample analytical results will be compared with the background threshold values on a point-by-point basis to determine the extent of site-related contamination. Therefore, the baseline condition (or null hypothesis) will be established as the COPC concentration in the OU2 sediment sample exceeds the background threshold value. The alternative condition (or alternative hypothesis) is the COPC concentration in the OU2 sediment sample does not exceed the background threshold value.

To avoid incorrectly concluding that OU2 COPC concentrations are below background threshold values when in fact they are above them (i.e., false rejection decision error), background threshold values will be calculated with a high degree of confidence (i.e., 95% confidence level, depending on the suitability of the data to support the calculation). Additionally, care will be taken to ensure that the background site analytical data set does

not include samples that appear to be affected by sources from the Site. As described in Step 5, suspect results (i.e., statistical outliers or samples from locations that have a PAH fingerprint consistent with coal tar from the Site) will be removed from the data set, and calculated background threshold value will be compared to published information for regional chemical concentrations in the lower Hudson River.

The statistical basis for the PAH fingerprinting study and associated performance criteria are presented in the PAH Fingerprinting Study Work Plan Addendum.

Performance criteria for addressing potential measurement error are specified in the, Field Sampling Plan (FSP) and Quality Assurance Project Plan (QAPP).

Step 7. Develop the Plan for Obtaining the Data

A stratified grid sample design will be used in the OU2 study area to characterize sediment quality. Two strata have been defined: A) from the shoreline of the Site to approximately 400 feet offshore, where COPC concentrations are expected to be highest and concentration gradients are expected to be greatest, including the area south of the Spencer Kellogg Pier; and B) the area to the north and east of the A grid, where COPC concentrations are expected to be more uniform and similar to regional background levels. A denser grid for the A grid is desired to support remedial planning because this is the area most likely to require sediment management.

A systematic grid sampling approach will be used as follows:

- A: systematic grid, approximate 100-foot spacing, 47 sample locations
- B: systematic grid, approximate 150-foot spacing, 30 sample locations

The TarGOST™ survey will be conducted at all 47 locations in the A grid, and at all stations previously characterized using CPT/ROST technology. The TarGOST™ survey will be conducted to a depth of 50 feet. If the lateral extent of coal tar extends beyond the A grid or is detected at previous CPT/ROST stations in the B grid, the survey will be conducted in the B grid. If the lateral or vertical extent of coal tar goes beyond these boundaries, recommendations for further characterization will be formulated as appropriate.

The surface and subsurface sediment sample design is as follows:

- Surface samples will be collected at every grid station at a depth of 0-0.5 foot.
- Subsurface (core) samples will be collected at a subset of stations: 8 stations in the A stratum and 6 stations in the B stratum. Core samples will be equally distributed (i.e., evenly spaced) throughout the A and B strata, but may be adjusted based on the results of the TarGOST™ survey – cores will not be collected in areas of heavy NAPL contamination.
- Subsurface samples will represent the following composite intervals: 0.5-1.0 foot, 1-2 feet, 2-4 feet, 4-6 feet, 6-8 feet, 8-10 feet, 12-14 feet, 16-18 feet, 22-24 feet, and 28-30 feet. The 2-foot composite samples from the remaining intervals deeper than 10 feet (e.g., 10-12 feet, 14-16 feet, 18-20 feet, 20-22 feet, 24-26 feet, and 26-28 feet) will be archived frozen for potential future analysis.

- Sediment samples will be collected at selected intervals from each TarGOST™ location to visually confirm the presence/absence of coal tar detected by the TarGOST™ instrument. If coal tar is detected at depths greater than 30 feet, an attempt will be made to collect sediment samples with the Geoprobe rig to evaluate the vertical extent of sediment contamination. This sample will be submitted to the laboratory for SVOC, PCB, and metals analysis (like all other sediment analytical samples) to assess the presence or absence of residual sediment contamination at depth
- Samples from three cores will be analyzed for Cesium-137. The three cores will be located along a transect perpendicular to the bulkhead at distances of approximately 275 feet, 475 feet, and 750 feet. Cores will be collected to a depth of 15 feet because of the possibility of high sedimentation rates adjacent to the Site. Sediment samples for Cesium-137 analysis will be collected in 2-inch increments to the base of the core. Initially, samples from 1 foot intervals will be submitted to the laboratory for analysis to broadly define the vertical extent of Cesium-137 activity. Additional intervals will be subsequently submitted for analysis to refine the activity profile.
- Surface sediment samples will be collected at five locations north of the former gypsum landfill, where elevated levels of PAHs were previously detected. Surface sediment samples (0-0.5 foot) will be collected at all five locations, and a sediment core will be collected at one station. Subsurface samples will be collected at depths of 0.5-1.0 foot, 1-2 feet, and 2-4 feet.
- Surface sediment samples will be collected from 20 upriver and downriver locations (10 upriver and 10 downriver). Proposed background locations were selected based on the criteria presented in Step 4.

Sediment samples will be analyzed for VOCs, SVOCs, PCBs, PCB congeners, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size distribution, and TOC. VOC analysis will be completed on samples within the A grid because VOC concentrations are expected to be measurable closest to the source areas. PCB congener analysis will be completed at each of the 14 Vibracore locations in the 0-0.5 foot and 0.5-1 foot intervals. Based on historic results from OU1 and OU2 pesticides will not be analyzed for in sediment samples. (Note that samples collected for the BERA will be analyzed for a broader list of analytes including pesticides).

A subset of samples will be analyzed for additional PAHs to support chemical fingerprinting. Sample numbers and locations for fingerprinting and analytical parameters are specified in the PAH Fingerprinting Study Work Plan Addendum.

Sediment samples from depths of 0-0.5 foot, 0.5-1.0 foot, 2-4 feet, 12- 14 feet, and 22-24 feet that are collected at each Vibracore location will be analyzed for the physical parameters specified in Step 3.

Sediment sampling will not be conducted during active dredging operations in the Hudson River that are nearby the Site.

Scope of work details to satisfy the DQOs are presented below.

1.4.2 Precision

Precision is an expression of the reproducibility of measurements of the same parameter under a given set of conditions. Specifically, it is a quantitative measurement of the variability of a group of measurements compared to their average value (EPA, 1987).

Precision is usually stated in terms of standard deviation, but other estimates, such as the coefficient of variation (relative standard deviation), range (maximum value minus minimum value), relative range, and relative percent difference (RPD) are common.

For this project, field sampling precision will be established by analyzing duplicate samples for the same parameters, and then, during data validation (Section 4) calculating the RPD for duplicate sample results.

The laboratory will determine analytical precision by calculating the RPD for the results of the analysis of internal QC duplicates and matrix spike duplicates.

The formula for calculating RPD is as follows:

$$\text{RPD} = \frac{|V1 - V2|}{(V1 + V2)/2} \times 100$$

where:

RPD	=	Relative Percent Difference.
V1, V2	=	The two values to be compared.
V1 - V2	=	The absolute value of the difference between the two values.
(V1 + V2)/2	=	The average of the two values.

The DQOs for analytical precision, calculated as the RPD between duplicate analyses, are presented in Tables 1 through 11.

1.4.3 Accuracy

Accuracy is a measure of the degree of agreement of a measured value with the true or expected value of the quantity of concern (Taylor, 1987), or the difference between a measured value and the true or accepted reference value. The accuracy of an analytical procedure is best evaluated by the analysis of a sample containing a known quantity of material, and is expressed as the percent of the known quantity that is recovered or measured. The recovery of a given analyte depends on the sample matrix, method of analysis, and the specific compound or element being analyzed. The concentration of the analyte relative to the detection limit of the analytical method is also a major factor in determining the accuracy of the measurement. Concentrations of analytes that are close to the detection limits are less accurate because they are more affected by such factors as instrument "noise". Higher concentrations will not be as affected by instrument noise or other variables and thus will be more accurate.

Sampling accuracy may be checked by assessing the analytical results of field blanks and trip blanks for each sample set. Analytical accuracy is typically assessed by examining the percent recoveries of surrogate compounds that are added to each sample (organic analyses only), and the percent recoveries of matrix spike compounds added to selected samples and laboratory blanks. A Blank Spike/Laboratory Control Spike (LCS) will also be analyzed to

provide additional information on analytical accuracy. Additionally, initial and continuing calibrations must be performed and accomplished within the established method control limits to define the instrument accuracy before analytical accuracy can be assured for any sample set.

Accuracy is normally measured as the percent recovery (%R) of a known amount of analyte, called a spike, added to a sample (matrix spike) or to a blank (blank spike).

The %R is calculated as follows:

$$\%R = \frac{SSR - SR}{SA} \times 100$$

where:

%R = Percent recovery.

SSR = Spike sample result: concentration of analyte obtained by analyzing the sample with the spike added.

SR = Sample result: the background value, i.e., the concentration of the analyte obtained by analyzing the sample.

SA = Spiked analyte: concentration of the analyte spike added to the sample.

The acceptance limits for accuracy for selected parameters are presented in Tables 1 through 11.

1.4.4 Representativeness

Representativeness expresses the degree to which sample data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition. Representativeness is a qualitative parameter that is concerned primarily with the proper design of the sampling program (EPA, 1987). Samples must be representative of the environmental media being sampled. Therefore, selection of sample locations and sampling procedures will incorporate consideration of obtaining the most representative sample possible.

Field and laboratory procedures will be performed to ensure, to the degree that is technically possible, that the data derived represents the in-place quality of the material sampled. Every effort will be made to ensure that chemical compounds will not be introduced into the sample via sample containers, handling, and analysis. Decontamination of sampling devices and digging equipment will be performed between samples, as outlined in the FSP. Laboratory sample containers will be certified as clean. Field blanks, trip blanks, and method blanks will also be monitored for potential sample contamination from field and laboratory procedures.

The assessment of representativeness also must consider the degree of heterogeneity in the material from which the samples are collected. Sampling heterogeneity will be evaluated during data validation through the analysis of coded field duplicate samples. The analytical laboratory will also follow acceptable procedures to assure that the samples are adequately homogenized prior to taking aliquots for analysis, so the reported results are representative of the sample received.

Chain-of-custody procedures will be followed to document that samples were not contaminated during container preparation, shipment, and sampling. Details of blank, duplicate, and chain-of-custody procedures are presented in Section 2.

1.4.5 Completeness

Completeness is defined as the percentage of measurements that are judged to be valid (EPA, 1987). The QA objective for completeness is generation of valid (i.e., useable) data for at least 90 percent of the analyses requested. Completeness is defined as follows for all sample measurements:

$$\%C = \frac{V}{T} \times 100$$

where:

- %C = Percent completeness.
- V = Number of measurements judged valid.
- T = Total number of measurements.

1.4.6 Comparability

Comparability expresses the degree of confidence with which one data set can be compared to another (EPA, 1987). The comparability of all data collected for this project will be ensured by:

- Using identified standard methods for both the sampling and analysis phases of this project
- Requiring traceability of all analytical standards and/or source materials to the U.S. Environmental Protection Agency (EPA) or National Institute of Standards and Technology (NIST)
- Requiring that all calibrations be verified with an independently prepared standard from a source other than that used for calibration (if applicable)
- Using standard reporting units and reporting formats including the reporting of QC data
- Performing a minimal data validation/review of all QA/QC data associated with the analytical results
- Performing a complete data validation on a representative fraction of the analytical results, including the use of data qualifiers in all cases where appropriate
- Requiring that all validation qualifiers be used any time an analytical result is used for any purpose

These steps will ensure that all future users of either the data or the conclusions drawn from them will be able to judge the comparability of these data and conclusions.

1.4.7 Sensitivity and Quantitation Limits

In addition to PARCC criteria in assessing data quality, the achievement of method detection limits depends on instrument sensitivity and matrix effects. Therefore, it is important to monitor instrument sensitivity to ensure data quality through constant instrument performance. Instrument sensitivity will be monitored through the analysis of method blanks and calibration check samples.

Tables 10 through 15 present the quantitation limits for all definitive data-quality-level laboratory analytical methods, compounds, and matrices to be analyzed for this project. Honeywell and the laboratory will establish agreed-upon contract-required quantitation limits before sample collection to ensure, as much as possible, that the quantitation limits meet the applicable or relevant and appropriate requirements (ARARs). In some instances the analytical methods may need to be modified by the laboratory to meet specific ARAR parameters.

1.5 Special Training/Certification

All personnel will be appropriately trained and certified as necessary. All persons involved in the fieldwork at the Site will be appropriately health and safety trained (i.e., 40-hour OSHA training and annual 8-hour OSHA refresher training). The laboratory shall be certified by the New Jersey Department of Environmental Protection. In addition, a New Jersey-licensed well driller will conduct all drilling activities, and a New Jersey-licensed surveyor will complete all land survey work. Before commencing work, all personnel will be required to present any necessary certificates or licenses to the Field Team Leader. A copy will be kept onsite and a copy will be forwarded to CH2M HILL.

1.6 Documents and Records

The most current approved copy of the QAPP, standard operating procedures (SOPs), or other relevant documents will be distributed by the CH2M HILL Project Manager or his designee. The recipient shall acknowledge receipt of the QAPP by returning a signed cover sheet. If or when a revised document is produced, the Project Manager or designee shall notify project staff verbally and then forward the current document.

Project data report packages will include selected reference materials, all field notes, (including sampling records, chain of custody forms, and all well permits and records), analytical results and QA/QC data, and any other relevant documents produced during the RI/FS. CH2M HILL will store these documents for 10 years.

SECTION 2

Data Generation and Acquisition Elements

2.1 Sampling Process Design (Experimental Design)

The sampling program will provide data concerning the presence, nature, and extent of contamination of sediments, if any. This section presents sample container preparation procedures, sample preservation procedures, sample holding times, and field QC sample requirements. Sample locations and the number of environmental and QC samples to be collected are specified in the Work Plan and FSP. All sampling procedures are presented in the FSP.

2.2 Sampling Methods

Sediments and surface water will be sampled and analyzed for selected organic and inorganic parameters (VOC, SVOC, PAH, PCB, and metals) following SW-846 methodology. Other data to be collected at the site include geotechnical data and tidal data (see Table 1-1 and 1-2 of the FSP). Detailed sampling procedures (i.e., deploying instruments, splitting, homogenization, compositing, or filtering samples) are presented in the FSP and the Work Plan for the Site. Performance requirements are presented in Section 1.4 of this QAPP.

Before use, all sample containers will be properly washed and decontaminated by either the analytical laboratory or the container vendor. Copies of the sample container QC analyses will be provided by the laboratory for each container lot used to obtain samples. Samples shall be preserved according to the preservation techniques given in Table 16. Preservatives will be added to the sample bottles by the laboratory before their shipment, in sufficient quantities to ensure that proper sample pH is met. Preservation will be checked in the field to verify that the appropriate pH has been achieved (e.g., ≤ 2 for aqueous metals samples). Following sample collection, the sample bottles should be placed in the shipping cooler, cooled to 4°C with ice.

If a problem occurs with the sampling methods, the Project Manager shall be notified in writing immediately and a copy of the correspondence shall be placed into the files.

2.3 Sample Handling and Custody

This section presents sample custody procedures for both the field and laboratory. Implementation of proper custody procedures for samples generated in the field is the responsibility of field personnel. Both laboratory and field personnel involved in the execution of the chain of custody and transfer of samples will be trained on the procedures prior to implementation. The applicable holding times for each matrix and analyses are stated in Table 16. Sample identification and designation is indicated in the FSP.

Evidence of sample traceability and integrity is provided by chain-of-custody procedures. These procedures document the sample traceability from the selection and preparation of

the sample containers by the laboratory, to sample collection, sample shipment, laboratory receipt, and analysis. A sample is considered to be in a person's custody if the sample is:

- In a person's possession
- Maintained in view after possession is accepted and documented
- Locked and tagged with custody seals so that no one can tamper with it after having been in physical custody
- In a secured area that is restricted to authorized personnel

An example chain-of-custody form and custody seal is included in the FSP.

2.3.1 Field Sample Custody

A chain-of-custody record accompanies the sample containers from selection and preparation at the laboratory, during shipment to the field for sample containment and preservation, and during return to the laboratory. Duplicate copies of the chain-of-custody must be completed for each sample set collected.

The chain-of-custody record lists the field personnel responsible for taking samples, the project name and number, the name of the analytical laboratory to which the samples are sent, and the method of sample shipment. It also lists a unique description of every sample bottle in the set. If samples are split and sent to different laboratories, a copy of the chain-of-custody record will be sent with each sample.

The Special Instructions space on the chain-of-custody form is used to indicate if the sample is a matrix spike, matrix spike duplicate, or any other sample information for the laboratory. Because they are not specific to any one-sample point, trip and field blanks are indicated on separate rows. Once all bottles are properly accounted for on the form, a sampler will write his or her signature and the date and time in the first RELINQUISHED BY space. The sampler will also write the method of shipment, the shipping cooler identification number, and the shipper air bill number on the top of the chain-of-custody. Mistakes will be crossed out with a single line in ink and initialed by the author.

Sampling personnel retain one copy of the chain-of-custody form and the other two copies are put into a sealable plastic bag and taped inside the lid of the shipping cooler. The cooler lid is closed, custody seals provided by the laboratory are affixed to the latch and across the back and front lids of the cooler, and the person relinquishing the samples signs their name across the seal. The seal is taped, and the cooler is wrapped tightly with clear packing tape. It is then relinquished by field personnel to personnel responsible for shipment, typically an overnight carrier. The chain-of-custody seal must be broken to open the container. Breakage of the seals before receipt at the laboratory may indicate tampering. If tampering is apparent, the laboratory will contact the Project Manager, and the sample will not be analyzed.

Copies of all executed chain-of-custodies and all data collected on-site will be sent to the CH2M HILL Philadelphia office.

2.3.2 Laboratory Sample Custody

The Project Manager or Field Team Leader will notify the laboratory of upcoming field sampling activities, and the subsequent shipment of samples to the laboratory. This notification will include information concerning the number and type of samples to be shipped as well as the anticipated date of arrival.

The following laboratory sample custody procedures will be used:

- The laboratory will designate a sample custodian who will be responsible for maintaining custody of the samples, and for maintaining all associated records documenting that custody.
- Upon receipt of the samples, the custodian will check cooler temperature, and check the original chain-of-custody documents and compare them with the labeled contents of each sample container for correctness and traceability. The sample custodian will sign the chain-of-custody record and record the date and time received.
- Care will be exercised to annotate any labeling or descriptive errors. In the event of discrepant documentation, the laboratory will immediately contact the Project Manager or Field Team Leader as part of the corrective action process. A qualitative assessment of each sample container will be performed to note any anomalies, such as broken or leaking bottles. This assessment will be recorded as part of the incoming chain-of-custody procedure.
- The samples will be stored in a secured area at a temperature of approximately 4 °C until analyses begin.
- A laboratory tracking record will accompany the sample or sample fraction through final analysis for control.
- A copy of the tracking record will accompany the laboratory report and will become a permanent part of the project records.

2.4 Analytical Methods

Samples will be analyzed according to the procedures specified by the current EPA and EPA SW-846 methods. The methods to be used for the laboratory analysis of water and sediment samples are presented in Table 16. These methods were selected because they best meet the requirements of the RI/FS. Specific performance criteria are discussed in Section 1.4 of this QAPP.

2.4.1 Metals Analyses

The inorganic analyses for surface water and sediment samples will be performed using SW-846 Method 6010B. These analyses will be either Inductively Coupled Plasma – Atomic Emission Spectroscopy (ICP-AES) or Inductively Coupled Plasma – Mass Spectrometry (ICP-MS). Mercury will be analyzed using SW-846 Method 7470/7471A using Cold Vapor Atomic Absorption (CVAA). Before any samples are analyzed, the instrument(s) must be properly calibrated in accordance with these methods and all QA/QC procedures.

2.4.2 Volatile Organic Analysis

Surface water and sediment samples will be analyzed for VOCs using SW-846 Method 8260B. Surface water samples will be analyzed using purge-and-trap "extraction," followed by gas chromatograph/mass spectrometer (GC/MS) analysis, and sediment samples will be analyzed using purge-and-trap or closed system purge-and-trap extraction, followed by GC/MS. Before any samples are analyzed, the instrument(s) must be properly calibrated in accordance with these methods and all QA/QC procedures.

2.4.3 Semivolatile Organic Analysis

Surface water and sediment samples will be analyzed for SVOCs using by SW-846 Method 8270C. Surface water samples will be analyzed using continuous liquid-liquid extraction, followed by GC/MS analysis. Sediment samples will be analyzed using sonication, automated soxhlet, or pressurized fluid extraction followed by GC/MS. Before any samples are analyzed, the instrument(s) must be properly calibrated in accordance with these methods and all QA/QC procedures.

2.4.4 PCB Analysis

Surface water and sediment samples will be analyzed for PCBs using SW-846 Method 8082. Surface water samples will be analyzed using continuous liquid-liquid or separatory funnel extraction, followed by dual column gas chromatograph/electron capture detector (GC/ECD) analysis. Sediment samples will be analyzed using sonication, automated soxhlet, or pressurized fluid extraction followed by GC/ECD analysis. Before any samples are analyzed, the instrument(s) must be properly calibrated in accordance with these method and all QA/QC procedures.

Additionally, PCB congeners will be analyzed using EPA method 1668a by Alta Analytical Laboratories.

2.4.5 Other Analyses

Sediment samples will be analyzed for TOC using SW-846 Method 9060, grain size distribution using ASTM method D422, and redox potential using ASTM method D1498-93, Atterberg limits using ASTM method D4318, specific gravity using ASTM method D854, water content using ASTM method D2216, organic content using ASTM method D2974, bulk density using ASTM method D2937, self weight consolidation using ASTM method D2435, permeability using ASTM method D2434, and shear strength using ASTM method D4767. Before any samples are analyzed, the instrument(s) must be properly calibrated in accordance with these methods and all QA/QC procedures.

PAH fingerprinting will also be performed on all sediment samples using a modified SW-846 Method 8270C. Batelle Laboratories will be performing these analyses.

Sediment samples will be analyzed for cesium-137 by gamma spectrometry by Flett Research.

2.4.6 Field Measurement Procedures

Field measurements of temperature, turbidity, salinity, dissolved oxygen, pH, specific conductance, ORP, and water levels will be performed at the time of sample collection. All parameters will be collected using a Horiba U-22 Water Quality Monitoring System except for water level measurements. The U-22 will be calibrated according to the manufacturer's specifications.

NAPL will be detected using the procedures outlined in the FSP. The process includes visual observations, jar-head space tests, TarGOST™ profiling, and analytical testing if necessary.

2.5 Quality Control

Each set of samples will be analyzed concurrently with calibration standards, method blanks, instrument blanks, storage blanks, internal standards, laboratory control spikes, matrix spikes (MS), matrix spike duplicates (MSD) or laboratory duplicates, and QC check samples (if required by the protocol). The frequency of the QC checks will be in accordance with the analytical methods and the FSP. The required calibration procedures are discussed in Section 2.7. The field personnel will designate the MS/MSD samples, if none have been designated, the laboratory will contact the project Quality Assurance Officer (QAO) for corrective action. A copy of the laboratory's quality assurance plan (LQAP), laboratory certification, and the results of Performance Evaluation (PE) samples from the past 6 months will be submitted to the EPA prior to the start of field work.

2.5.1 Calibration Standards and Surrogates

All organic standard and surrogate compounds are checked by the method of mass spectrometry for correct identification and gas chromatography for degree of purity and concentration. All standards are traceable to a source of known quality certified by the EPA or NIST, or other similar program. When the compounds pass the identity and purity tests, they are certified for use in standard and surrogate solutions. Concentrations of the solutions are checked for accuracy before release for laboratory use. Standard solutions are replaced monthly or more frequently, based on data indicating their deterioration.

2.5.2 Organic Blanks

Analysis of blank samples verifies that the analytical method does not introduce contaminants or detect "false positives." The blank water sample can be generated by reverse osmosis and Super-Q filtration systems, or distillation of water containing KMnO_4 . The laboratory control spike is generated by addition of standards containing surrogate and target compounds to a "clean matrix," such as blank water or Ottawa sand, for organic analyses.

All blank water samples (trip blanks and lab-provided water for equipment rinsate blanks) will be prepared for the laboratory in the same manner as water used by the laboratory for analysis, and will be traceable to a specific laboratory method or instrument blank analysis.

2.5.3 Field QC Samples

To assess field sampling and decontamination performance, two types of "blanks" will be collected and submitted to the laboratory for analyses. In addition, the precision of field sampling procedures will be assessed by collecting coded field duplicates and MS/MSDs. The blanks will include:

- Trip Blanks— A trip blank will be prepared before the laboratory sends the sample containers. The trip blank will consist of a 40-ml volatile organic analytic vial containing distilled, deionized water, which accompanies the other aqueous and methanol-preserved soil sample bottles into the field and back to the laboratory. A trip blank will be included with each shipment of water samples for TCL volatiles analysis. The trip blank will be analyzed for TCL volatile organic compounds to detect any contamination from sampling and transport, and internal laboratory procedures.
- Equipment Blanks— Equipment blanks will be taken at a frequency of one per decontamination event, maximum of one day per sampling equipment type, minimum of one per week. An equipment blank is used to assess the effectiveness of the decontamination procedures for sampling equipment. It is a sample of deionized, distilled water provided by the laboratory, which has passed through a decontaminated bailer or other sampling apparatus. It is usually collected as a last step in the decontamination procedure, before taking an aqueous sample. The equipment blank may be analyzed for all of the parameters of interest.
- Duplicates will consist of:
 - Field Duplicate— To assess the representativeness of the sampling methods, field duplicates will be collected at a frequency of one per 20 environmental samples per matrix.
 - Matrix Spike/Matrix Spike Duplicate— MS/MSD samples (MS/MSD for organics; MS and laboratory duplicate for inorganics) will be taken at a frequency of one pair per 20 field samples. These samples are used to assess the effect of the sample matrix on the recovery of target compounds or target analytes. The percent recoveries and RPDs are given in Tables 1 through 11.

2.6 Instrument/Equipment Testing, Inspection, and Maintenance

2.6.1 Preventive Maintenance Procedures

Equipment, instruments, tools, gauges, and other items requiring preventive maintenance will be serviced in accordance with the manufacturer's specified recommendations and written procedures developed by the operators.

The manufacturer established a list of critical spare parts, so that commonly needed parts can be inventoried and stored at the laboratory. These spare parts are made available to reduce the downtime. A service contract for rapid instrument repair or backup instruments

may be substituted for the spare part inventory. A maintenance log is kept with each instrument to record all maintenance.

2.6.2 Schedules

Written procedures (i.e., SOPs, analytical methods, and operating manuals) will establish the schedule for servicing critical items in order to minimize the downtime of the measurement system. The laboratory will adhere to the maintenance schedule, and arrange any necessary and prompt service. Qualified personnel will perform the required service.

2.6.3 Records

Logs shall be established to record and control maintenance and service procedures and schedules. All maintenance records will be documented and traceable to the specific equipment, instruments, tools, and gauges. Records produced shall be reviewed, maintained, and filed by the operators at the laboratories. The QAO may audit these records to verify complete adherence to these procedures.

2.7 Instrument/Equipment Calibration and Frequency

2.7.1 Field Instruments

All field analytical equipment will be calibrated immediately before each day's use. The calibration procedures will conform to manufacturer's standard instructions to ensure that the equipment is functioning within the allowable tolerances established by the manufacturer and required by the project. Records of all instrument calibration will be maintained by the Field Team Leader and will be subjected to audit by the project QAO. The Field Team Leader will maintain copies of all the instrument manuals onsite.

Calibration procedures for instruments used for monitoring health and safety hazards (e.g., photoionization detectors/flame ionization detectors (PID/FID) and combustible gas meter) are provided in the Health and Safety Plan (HSP).

2.7.2 Laboratory Instruments

The laboratory will follow all calibration procedures and schedules as specified by the current methods for organic and inorganic analyses and the laboratory SOPs that apply to the instruments necessary for the analytical methods given in Table 16.

Gas Chromatograph/Mass Spectrometer (GC/MS)

Before samples are analyzed, this instrument is tuned with bromofluorobenzene for volatile compounds and decafluorotriphenylphosphine for semivolatile compounds, or other tune criteria as specified by the method used. No samples are analyzed until the instrument has met the tuning criteria of the method.

In general, the GC/MS then calibrated for all target compounds. An initial calibration curve is produced to define the working range to establish criteria for identification. This initial calibration is evaluated every 12 hours before sample analysis. If the daily standard does not meet the established criteria, the system is recalibrated.

Gas Chromatograph (GC)

Before samples are analyzed, the GC is calibrated for all target compounds. An initial calibration curve is produced to define the working range to establish criteria for identification. The calibration is monitored throughout the day by analyzing Continuing Calibration Verification (CCV) standards. If the verification standard does not meet established criteria, corrective action is performed, which may include analyzing another calibration curve.

Metals—ICP and AA

Each ICP is calibrated before use by analyzing a multi-element calibration standard. The calibration is then verified using standards from an independent source. For CLP linear range verification check standard is analyzed and reported quarterly for each element analyzed by ICP. This concentration is the upper limit of the ICP linear range and any result found above this limit must be diluted and reanalyzed. The calibration is monitored throughout the day by analyzing a Continuing Calibration Blank and a CCV standard. If the verification standard does not meet established criteria, corrective action is performed.

Each atomic absorption (AA) unit is calibrated prior to any analyses being conducted. A calibration curve is prepared with a minimum of a calibration blank and three standards and then verified with a standard that has been prepared from an independent source at a concentration near the middle of the calibration range. The calibration is then verified on an ongoing basis with a calibration blank and CCV. If the ongoing calibration standard does not meet established acceptance criteria, corrective action is performed.

All samples for furnace analyses are single-spiked. The method of standard additions or sample dilution is used when the single spike analysis indicated matrix interferences are present.

Wet Chemistry

The field of classical (wet) chemistry involves a variety of instrumental and wet chemical techniques. Calibration and standardization procedures vary depending on the system and analytical methodology required for a specific analysis. The calibration is checked on an ongoing basis to ensure that the system remains within specifications. If the ongoing calibration check does not meet established criteria, analysis is halted and corrective action is taken. The procedures include examination of instrument performance and recalibration and reanalysis of samples back to the previous acceptable calibration check.

2.8 Inspection/Acceptance of Supplies and Consumables

Supplies critical to the project are listed in the FSP. The Field Team Manager will be responsible for ensuring that the proper equipment is present and available. The Field Team Leader shall establish a secure storage area for all equipment. All equipment shall be certified clean by the supplier.

2.9 Non-Direct Measurements

Data from previous sampling events for the Quanta Resources Site are presented in the Removal Site Investigation (RSI) (GeoSyntec 2000) and Engineering Evaluation / Cost Analysis (EE/CA) Reports (GeoSyntec 2001). The data include analytical results for sediment, along with geological cross sections, figures, and other field investigation results. Other data that may be used include chemical background, tide data, and stream flow data from the Hudson River from a variety of sources.

The data from the RSI and EE/CA were used to locate areas that needed further investigation and to design the RI/FS Work Plan and FSP. Previously collected analytical results will also be reviewed for quality assurance, or validated if the appropriate analytical laboratory reports and supporting laboratory documentation are available.

2.10 Data Management

2.10.1 Introduction

Data collected during the field investigation will be reduced and reviewed, and a report on the findings will be tabulated in a standard format. The criteria used to identify and quantify the analytes will be those specified in the analytical methods. Data deliverables will be reported as "CLP-like" Sample Delivery Groups (SDGs). In addition, EPA shall have access to the lab and site data upon request.

The completed copies of the chain-of-custody records (both external and internal) accompanying each sample from time of initial bottle preparation to completion of analysis shall be attached to the analytical reports.

2.10.2 Analytical Data Reduction

The Data Package will consist of CDs containing the data package in PDF format and hard copies. The CH2M HILL Project Sample Manager (PSM) will be sent a CD, while the CH2M HILL Project Chemist (PC) will be sent a CD and the hardcopy data package. The CH2M HILL Project Data Manager (PDM) will be sent the electronic data deliverable, with a copy sent to the CH2M HILL PC. The laboratory will provide the data package deliverables 14 business days after sample receipt of a complete sample delivery group. The CH2M HILL PC or QA reviewer will check the package to ensure all deliverables have been provided by performing validation. If problems are identified, the laboratory will be alerted, and corrective actions will be requested. Upon completion of the data validation, the data will be used to generate summary tables. These tables will form the database for assessment of the site contamination condition.

The electronic data deliverable (EDD) formats will be submitted according to the Honeywell requirements. The Honeywell EDD is called the 'EIM53' format consisting of 53 data fields. Specifications will be provided to the laboratory prior to sampling. All deliverables must also undergo a QC check by the laboratory before delivery. The original data, tabulations, and electronic media are stored in a secure and retrievable fashion.

Electronic deliverables are to be uploaded directly to the Honeywell database system (Locus Focus EIM) by the laboratory. The PDM will work with the laboratory prior to sampling to verify that the laboratory has access to the correct database and understands the EDD uploading procedures. A copy of the electronic deliverable will be sent to the PC and PDM for storage.

The Project Manager or PDM will maintain close contact with the PC or QA reviewer to ensure all non-conformance issues are acted upon prior to data manipulation and assessment routines. Once the QA review has been completed, the Project Manager may direct the Team Leaders or others to complete the analytical data assessment.

Assessment and Oversight

3.1 Assessment and Response Actions

3.1.1 Assessment

Quality assurance audits may be performed by or under the direction of the project QM. These audits will be conducted to evaluate the capability and performance of project and subcontractor personnel, items, activities, and documentation of the measurement system(s). The QM may plan, schedule, and approve system and performance audits based on a CH2M HILL SOP customized to the project requirements. At times, the QM may request additional personnel with specific expertise from company and/or project groups to assist in conducting performance audits. However, these personnel will not have responsibility for the project work associated with the performance audit.

3.1.2 System Audits

System audits, performed by the QM or designated auditors, will encompass a qualitative evaluation of measurement system components to ascertain their appropriate selection and application. In addition, field and laboratory quality control procedures and associated documentation may be system audited. These audits may be performed once during the performance of the project. However, if conditions adverse to quality are detected or if the Project Manager requests, additional audits may take place.

3.1.3 Performance Audits

The laboratory will be required to conduct an analysis of PE samples or provide proof that PE samples submitted by EPA or a state agency have been analyzed within the past 12 months.

3.1.4 Formal Audits

Formal audits refer to any system or performance audit that is documented and implemented by the QM. These audits encompass documented activities performed by qualified lead auditors to a written procedure or checklists to objectively verify that QA requirements have been developed, documented, and instituted in accordance with contractual and project criteria. Formal audits may be performed on project and subcontractor work at various locations.

Auditors who have performed the site audit after gathering and evaluating all data will write audit reports. Items, activities, and documents found by lead auditors to be in noncompliance shall be identified at exit interviews conducted with the involved management. Non-compliances will be logged and documented through audit findings, which are attached to and are a part of the integral audit report. These audit-finding forms are directed to management to satisfactorily resolve the noncompliance in a specified and timely manner.

The Project Manager has overall responsibility to ensure that all corrective actions necessary to resolve audit findings are acted upon promptly and satisfactorily. Audit reports must be submitted to the Project Manager within 15 days of completion of the audit. Serious deficiencies will be reported to the Project Manager within 24 hours. All audit checklists, audit reports, audit findings, and acceptable resolutions are approved by the QM before being issued. Acceptable resolutions may be verified by re-audit or documented surveillance of the item or activity. Upon verification acceptance, the QM will close out the audit report and findings.

3.1.5 Corrective Action

The following procedures have been established to ensure that conditions adverse to quality, such as malfunctions, deficiencies, deviations, and errors, are promptly investigated, documented, evaluated, and corrected. Corrective action forms are included in the FSP.

3.1.6 Corrective Action Procedure Description

When a significant condition adverse to quality is noted at the Site, laboratory, or subcontractor location, the cause of the condition will be identified and corrective action will be taken to preclude repetition. Condition identification, cause, reference documents, and planned corrective action will be documented and reported to the QM, Project Manager, Field Team Leader and involved subcontractor management, at a minimum. Implementation of corrective action is verified by documented follow-up action.

All project personnel have the responsibility, as part of their normal work duties, to promptly identify, solicit approved correction, and report conditions adverse to quality. Corrective actions will be initiated as follows:

- When predetermined acceptance standards are not attained
- When procedures or data compiled are found to be deficient
- When equipment or instrumentation is found to be faulty
- When samples and analytical test results are not clearly traceable
- When QA requirements have been violated
- When designated approvals have been circumvented
- As a result of system and performance audits
- As a result of a management assessment
- As a result of laboratory/field comparison studies
- As required by EPA and EPA SW-846 methods

Project management and staff, such as field investigation teams, remedial response planning personnel, and laboratory groups, monitor ongoing work performance in the normal course of daily responsibilities. Work may be audited at the CH2M HILL office, sites, laboratories, or subcontractor locations. Activities or documents identified as noncompliant with QA requirements will be documented. Corrective actions will be mandated through audit finding sheets attached to the audit report. Audit findings are logged, maintained, and controlled by the Task Manager.

Personnel assigned to QA functions will have the responsibility to issue and control Corrective Action Request (CAR) forms (see the FSP). The CAR identifies the

out-of-compliance condition, reference document(s), and recommended corrective action(s) to be administered. The CAR is issued to the personnel responsible for the affected item or activity. A copy is also submitted to the Project Manager. The individual to whom the CAR is addressed returns the requested response promptly to the QA personnel, affixing his/her signature and date to the corrective action block, after stating the cause of the conditions and corrective action to be taken. The QA personnel maintain the log for status of CARs, confirms the adequacy of the intended corrective action, and verifies its implementation. CARs will be retained in the project file for the records.

Any project personnel may identify noncompliance issues; however, the designated QA personnel are responsible for documenting, numbering, logging, and verifying the closeout action. The Project Manager will be responsible for ensuring that all recommended corrective actions are implemented, documented, and approved.

CH2M HILL management personnel receive QA reports appropriate to their level of responsibility. The Project Manager receives copies of all QA documentation. QC documentation is retained within the department that generated the product or service except where this documentation is a deliverable for a specific contract. QC documentation is also submitted to the QM for review and approval. Previous sections detailed the QA activities and the reports that they generate. A final audit report for each project may also be prepared. The reports may include:

- periodic assessment of measurement data accuracy, precision, and completeness
- results of performance audits and/or system audits
- significant QA problems and recommended solutions for future projects
- status of solutions to any problems previously identified

SECTION 4

Data Validation and Usability Elements

4.1 Data Review, Verification, and Validation

Data validation will be conducted under the guidelines set forth in the Contract Laboratory Program National Functional Guidelines for Organic Data Review (EPA, 1999) and the Contract Laboratory Program National Functional Guidelines for Inorganic Data Review (EPA, 2002), using the QC as set forth in the analytical methods and this QAPP.

A data validation report will be prepared and reviewed by the QAO before issuance. The report will present the results of data validation, including a summary assessment of laboratory data packages, sample preservation, and chain-of-custody procedures; and a summary assessment of PARCC for each analytical method. A detailed assessment of each SDG will follow. For each of the organic analytical methods, the following will be assessed:

- Holding times
- Percentage of solids
- Instrument tuning
- Sample preservation and holding times
- Instrument calibrations
- Blank results
- System monitoring compounds or surrogate recovery compounds (as applicable)
- Internal standard recovery results
- MS and MSD results
- Laboratory control sample results
- Target compound identification
- Chromatogram quality
- Pesticide cleanup (if applicable)
- Duplicate results
- Compound quantitation and reported detection limits
- System performance
- Results verification
- For each of the inorganic compounds, the following will be assessed:
 - Holding times
 - Percentage of solids
 - Calibrations
 - Blank results
 - Sample preservatives
 - Interference control sample
 - Laboratory check samples
 - Duplicates
 - MS
 - Furnace atomic absorption analysis QC

- ICP serial dilutions
- Results verification and reported detection limits

Based on the results of data validation, the validated analytical results reported by the laboratory will be assigned one of the following usability flags:

- U—Not detected at given value
- UJ—Estimated not detected at given value
- J—Estimated value
- N—Presumptive evidence at the value given
- NJ—The analysis indicates the presence of an analyte that has been tentatively identifies and the associated numerical value represents its approximate concentration
- R—Result not useable
- No Flag—Result accepted without qualification

4.2 Verification and Validation Methods

Records generated during field activities will be verified to ensure that field activity data are acceptable (for example, that the correct sampling method was used and equipment was calibrated properly). Instrument calibration logs, field notebooks and logs, and chain-of-custody forms will be reviewed for completeness and accuracy. A summary of all data collected will be created, along with a list of any deviations and their impact on data quality.

Analytical laboratory data will be validated in accordance with the EPA (2002) *Guidance on Environmental Data Verification and Data Validation (QA/G-8)*, the Region II SOP for data validation, and this document. Five steps will be followed for the data validation of analytical laboratory records (EPA, 2002):

- Assemble planning documents and data to be validated. Review data verification records to determine method, procedural, and contractual required QC compliance/non-compliance
- Review verified, reported sample results collectively for the data set as a whole, including laboratory qualifiers
- Summarize data and QC deficiencies and evaluate the impact on overall data quality
- Assign data validation qualifiers as necessary
- Prepare analytical data validation reports.

Analytical and other data collected during previous investigations at adjacent properties will be used for site characterization. Only those data from these investigations that have been validated will be used for risk assessment.

4.3 Reconciliation with User Requirements

The data collected during this RI/FS will undergo a systematic review for compliance with the DQOs and performance objectives as stated in Section 1. In particular, laboratory and field data will be reviewed for compliance with the method QC criteria for performance and accuracy. The chemical data will be qualified according to EPA Region II SOPs and reported. These data will be evaluated as to usability. In particular, data outside QC criteria, but not rejected, will be reviewed for the magnitude of possible positive and negative bias.

A data usability report, which summarizes the implications of the use of any data out of criteria, will be written for each round of data. In addition, the data usability report will include the percentage of sample completeness for critical and non-critical samples and a discussion of any issues in representativeness of the data that may develop as a result of validation. The data usability report will discuss overall data quality and achievement of PARCC and will describe issues associated with the overall data.

After data validation in accordance with EPA Region II SOPs, EPA CLP, and this QAPP, the data will be evaluated as to consistency with site conditions and developed conceptual models. All data collected will be reconciled with the requirements stated in this QAPP and will be deemed usable for the project goals. In cases where data may be considered not usable (i.e., rejected during data validation because of to sample matrix interferences, exceedances of holding times, poor laboratory performance, etc.), resampling may be required at a specific location.

SECTION 5

References

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TABLE 1

Quality Control Limits for Volatiles in Water, Method 8260B

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
Acetone		32-166	24	53-154
Benzene		51-138	13	77-121
Bromodichloromethane		76-134	13	82-129
Bromoform		60-137	13	71-135
Bromomethane		62-137	15	68-133
2-Butanone		47-146	19	53-141
Carbon disulfide		54-135	15	52-134
Carbon tetrachloride		65-148	17	73-140
Chlorobenzene		76-120	12	80-118
Chloroethane		61-144	18	69-138
Chloroform		74-127	14	79-125
Chloromethane		53-142	20	55-152
Cyclohexane		50-148	15	62-124
1,2-Dibromo-3-chloropropane		65-136	14	68-132
Dibromochloromethane		70-128	11	80-125
1,2-Dibromoethane		73-124	12	79-122
1,2-Dichlorobenzene		73-123	10	79-116
1,3-Dichlorobenzene		75-120	12	76-120
1,4-Dichlorobenzene		71-120	12	77-119
Dichlorodifluoromethane		53-157	20	49-184
1,1-Dichloroethane		70-132	14	77-123
1,2-Dichloroethane		63-142	15	66-137
1,1-Dichloroethene		63-135	15	64-125
cis-1,2-Dichloroethene		70-130	10	75-120
trans-1,2-Dichloroethene		69-128	13	72-121
1,2-Dichloropropane		76-123	11	80-119
cis-1,3-Dichloropropene		74-123	12	79-120
trans-1,3-Dichloropropene		73-128	12	78-125
Ethylbenzene		51-142	14	80-124

TABLE 1

Quality Control Limits for Volatiles in Water, Method 8260B

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
Freon 113		62-140	17	73-133
2-Hexanone		51-145	18	52-147
Isopropylbenzene		65-135	11	75-132
Methyl Acetate		45-151	16	52-147
Methylcyclohexane		56-142	16	71-128
Methyl Tert Butyl Ether		42-149	13	72-124
4-Methyl-2-pentanone		58-142	15	64-141
Methylene chloride		73-128	12	75-121
Styrene		74-131	10	82-128
1,1,2,2-Tetrachloroethane		70-126	11	72-123
Tetrachloroethene		66-129	14	65-135
Toluene		49-147	13	79-122
1,2,4-Trichlorobenzene		68-126	12	71-128
1,1,1-Trichloroethane		69-140	15	77-135
1,1,2-Trichloroethane		81-121	12	83-120
Trichloroethene		64-139	13	81-123
Trichlorofluoromethane		59-158	17	70-157
Vinyl chloride		56-146	18	61-150
Xylene (total)		46-146	13	82-121
1,2-Dichloroethane-d4	65-133			
4-Bromofluorobenzene	79-124			
Dibromofluoromethane	77-121			
Toluene-d8	80-117			

TABLE 2

Quality Control Limits for Volatiles in Sediment, Method 8260B

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
Acetone		20–185	32	32–171
Benzene		49–134	17	79–118
Bromodichloromethane		51–140	17	80–125
Bromoform		40–145	21	67–135
Bromomethane		10–141	30	61–133
2-Butanone		31–163	29	50–150
Carbon disulfide		35–136	22	58–131
Carbon tetrachloride		39–149	21	70–137
Chlorobenzene		42–142	20	80–120
Chloroethane		10–140	26	64–135
Chloroform		56–132	17	78–123
Chloromethane		43–137	21	54–150
Cyclohexane		30–149	24	62–129
1,2-Dibromo-3-chloropropane		35–148	27	61–132
Dibromochloromethane		48–145	19	76–132
1,2-Dibromoethane		52–139	20	80–125
1,2-Dichlorobenzene		31–150	26	78–120
1,3-Dichlorobenzene		29–151	27	78–120
1,4-Dichlorobenzene		30–145	27	76–117
Dichlorodifluoromethane		29–160	22	49–174
1,1-Dichloroethane		56–131	16	76–123
1,2-Dichloroethane		53–138	18	74–132
1,1-Dichloroethene		47–136	20	70–124
cis-1,2-Dichloroethene		52–134	17	77–120
trans-1,2-Dichloroethene		47–134	19	75–120
1,2-Dichloropropane		56–131	16	79–120
cis-1,3-Dichloropropene		47–136	18	80–120
trans-1,3-Dichloropropene		45–138	20	78–123
Ethylbenzene		37–148	23	81–122

TABLE 2

Quality Control Limits for Volatiles in Sediment, Method 8260B

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
Freon 113		35-145	22	60-136
2-Hexanone		25-166	30	47-154
Isopropylbenzene		31-156	26	75-126
Methyl Acetate		38-176	31	55-149
Methylcyclohexane		16-161	28	58-137
Methyl Tert Butyl Ether		55-135	19	74-125
4-Methyl-2-pentanone		45-145	26	67-137
Methylene chloride		54-132	17	74-122
Styrene		37-150	24	81-126
1,1,2,2-Tetrachloroethane		45-143	25	72-127
Tetrachloroethene		34-162	25	69-131
Toluene		41-143	19	81-120
1,2,4-Trichlorobenzene		10-165	31	48-140
1,1,1-Trichloroethane		48-139	19	75-129
1,1,2-Trichloroethane		55-137	19	80-122
Trichloroethene		42-145	19	79-121
Trichlorofluoromethane		37-143	25	64-147
Vinyl chloride		46-136	21	63-141
Xylene (total)		35-150	17	81-122
1,2-Dichloroethane-d4	61-133			
4-Bromofluorobenzene	65-142			
Dibromofluoromethane	70-120			
Toluene-d8	75-123			

TABLE 3

Quality Control Limits for Semivolatiles in Water, Method 8270C / 8270C SIM

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
2-Chlorophenol		37-122	26	55-103
4-Chloro-3-methylphenol		43-128	24	58-116
2,4-Dichlorophenol		38-124	26	61-115
2,4-Dimethylphenol		32-130	25	45-120
2,4-Dinitrophenol		10-146	30	27-131
4,6-Dinitro-o-cresol		23-140	29	52-124
2-Methylphenol		29-108	27	40-125
3&4-Methylphenol		25-105	26	30-125
2-Nitrophenol		35-125	27	60-115
4-Nitrophenol		10-109	40	10-125
Pentachlorophenol (SIM)		22-128	30	18-127
Phenol		10-125	30	10-125
2,4,5-Trichlorophenol		50-120	25	64-112
2,4,6-Trichlorophenol		46-122	26	65-115
Acenaphthene (SIM)		38-116	30	43-121
Acenaphthylene (SIM)		28-125	24	38-122
Acetophenone		27-134	29	57-116
Anthracene (SIM)		43-123	24	47-124
Atrazine		23-166	25	34-170
Benzaldehyde		10-150	37	10-150
Benzo(a)anthracene (SIM)		52-109	29	38-132
Benzo(a)pyrene (SIM)		27-125	30	32-137
Benzo(b)fluoranthene (SIM)		22-129	31	32-136
Benzo(g,h,i)perylene (SIM)		14-124	29	43-124
Benzo(k)fluoranthene (SIM)		39-116	31	36-140
4-Bromophenyl-phenyl ether		49-118	24	61-115
Butyl benzyl phthalate		48-126	21	55-122

TABLE 3

Quality Control Limits for Semivolatiles in Water, Method 8270C / 8270C SIM

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
1,1'-Biphenyl		41-116	29	62-110
2-Chloronaphthalene		39-114	28	58-112
4-Chloroaniline		10-125	33	35-124
Carbazole		52-138	22	62-131
Caprolactam		10-125	40	10-125
Chrysene (SIM)		42-117	34	51-120
bis(2-Chloroethoxy)methane		34-122	29	52-121
bis(2-Chloroethyl)ether		29-119	32	50-113
Bis(2-Chloroisopropyl)ether		31-121	32	56-112
4-Chlorophenol phenyl ether		42-116	29	58-113
2,4-Dinitrotoluene		45-129	25	63-121
2,6-Dinitrotoluene		46-125	26	64-120
3,3'-Dichlorobenzidine		10-139	40	41-132
Dibenzo(a,h)anthracene (SIM)		10-126	32	43-125
Dibenzofuran		44-116	27	62-111
di-n-Butylphthalate		52-120	23	59-120
di-n-Octylphthalate		45-147	24	57-135
Diethylphthalate		46-118	24	55-119
Dimethylphthalate		40-119	27	52-118
bis(2-Ethylhexyl)phthalate		49-130	24	56-125
Fluoranthene (SIM)		40-127	22	40-136
Fluorene (SIM)		47-115	27	48-119
Hexachlorobenzene (SIM)		48-116	30	52-116
Hexachlorobutadiene		29-119	30	48-114
Hexachlorocyclopentadiene		10-110	38	14-119
Hexachloroethane		24-118	33	49-107
Indeno(1,2,3-cd)pyrene (SIM)		10-127	30	44-127
Isophorone		36-117	29	55-114
2-Methylnaphthalene		30-121	27	53-107

TABLE 3

Quality Control Limits for Semivolatiles in Water, Method 8270C / 8270C SIM
Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
2-Nitroaniline		39–130	30	55–127
3-Nitroaniline		14–133	33	42–128
4-Nitroaniline		19–139	34	38–141
Naphthalene (SIM)		28–137	26	31–128
Nitrobenzene		37–117	28	57–110
n-Nitroso-di-n-dipropylamine		28–125	29	53–118
n-Nitrosodiphenylamine		38–128	26	59–112
Phenanthrene (SIM)		46–119	32	44–124
Pyrene (SIM)		41–128	29	42–130
2,4,6-Tribromophenol	42–128			
2-Fluorobiphenyl	34–113			
2-Fluorophenol	12–76			
Nitrobenzene-d5	30–122			
Phenol-d5	10–59			
Terphenyl-d14	42–125			
2,4,6-Tribromophenol (SIM)	10–140			
2-Fluorobiphenyl (SIM)	10–133			
2-Fluorophenol (SIM)	10–99			
Nitrobenzene-d5 (SIM)	11–140			
Phenol-d5 (SIM)	10–83			
Terphenyl-d14 (SIM)	42–125			

TABLE 4

Quality Control Limits for Semivolatiles in Sediment, Method 8270C
Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
2-Chlorophenol		43-107	16	65-107
4-Chloro-3-methylphenol		42-124	20	64-118
2,4-Dichlorophenol		41-116	19	65-112
2,4-Dimethylphenol		39-123	19	60-116
2,4-Dinitrophenol		10-125	45	26-132
4,6-Dinitro-o-cresol		10-125	47	48-127
2-Methylphenol		39-108	20	61-105
3&4-Methylphenol		38-112	21	62-106
2-Nitrophenol		24-115	28	59-113
4-Nitrophenol		14-138	34	39-134
Pentachlorophenol		22-125	21	44-120
Phenol		40-109	18	61-109
2,4,5-Trichlorophenol		47-117	19	69-111
2,4,6-Trichlorophenol		47-118	17	69-111
Acenaphthene		31-118	25	63-101
Acenaphthylene		31-105	22	58-93
Acetophenone		22-111	23	52-100
Anthracene		31-129	32	67-110
Atrazine		19-171	25	36-173
Benzaldehyde		10-188	53	10-178
Benzo(a)anthracene		31-129	33	64-113
Benzo(a)pyrene		26-133	33	64-110
Benzo(b)fluoranthene		21-151	40	60-120
Benzo(g,h,i)perylene		10-132	35	52-121
Benzo(k)fluoranthene		29-142	37	58-121
4-Bromophenyl-phenyl ether		45-116	22	64-113
Butyl benzyl phthalate		23-146	34	58-121

TABLE 4
Quality Control Limits for Semivolatiles in Sediment, Method 8270C
Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
1,1'-Biphenyl		37-118	21	65-106
2-Chloronaphthanthene		41-109	20	64-105
4-Chloroaniline		10-125	34	19-104
Carbazole		39-140	26	62-135
Caprolactam		20-137	35	47-132
Chrysene		27-134	32	64-114
bis(2-Chloroethoxy)methane		32-115	21	52-115
bis(2-Chloroethyl)ether		27-107	24	47-108
Bis(2-Chloroisopropyl)ether		28-115	24	55-109
4-Chlorophenol phenyl ether		40-115	20	62-110
2,4-Dinitrotoluene		28-127	32	66-122
2,6-Dinitrotoluene		39-118	26	66-118
3,3'-Dichlorobenzidine		10-115	46	28-128
Dibenzo(a,h)anthracene		18-125	31	56-122
Dibenzofuran		36-118	25	64-109
di-n-Butylphthalate		42-122	20	62-120
di-n-Octylphthalate		10-188	32	58-138
Diethylphthalate		45-113	19	63-113
Dimethylphthalate		43-112	21	64-108
bis(2-Ethylhexyl)phthalate		20-156	33	56-126
Fluoranthene		28-130	39	66-112
Fluorene		35-123	25	66-108
Hexachlorobenzene		50-115	18	64-119
Hexachlorobutadiene		32-113	20	54-113
Hexachlorocyclopentadiene		10-125	50	16-119
Hexachloroethane		12-113	28	56-125
Indeno(1,2,3-cd)pyrene		12-134	34	57-124
Isophorone		30-112	21	53-109
2-Methylnaphthalene		25-120	23	53-107

TABLE 4

Quality Control Limits for Semivolatiles in Sediment, Method 8270C

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate Accuracy (% Rec.)	MS/MSD Accuracy (% Rec.)	MS/MSD Precision (% RPD)	Blank Spike Accuracy (% Rec.)
2-Nitroaniline		36-124	32	57-125
3-Nitroaniline		16-118	39	33-125
4-Nitroaniline		14-128	34	33-149
Naphthalene		24-115	25	56-125
Nitrobenzene		27-113	27	55-106
n-Nitroso-di-n-dipropylamine		24-120	22	51-113
n-Nitrosodiphenylamine		35-129	25	62-113
Phenanthrene		31-128	39	66-108
Pyrene		18-149	42	59-115
2,4,6-Tribromophenol	33-124			
2-Fluorobiphenyl	40-106			
2-Fluorophenol	33-105			
Nitrobenzene-d5	26-113			
Phenol-d5	34-110			
Terphenyl-d14	35-142			

TABLE 5

Quality Control Limits for Pesticides in Water, Method 8081A
Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate (% Rec)	MS/MSD (% Rec)	MS/MSD (% RPD)	Blank Spike (% Rec)
Aldrin		52-137	30	68-130
alpha-BHC		59-139	26	76-135
Beta-BHC		72-137	27	78-130
delta-BHC		66-153	21	72-143
gamma-BHC (Lindane)		64-140	23	78-135
alpha-Chlordane		51-155	23	79-137
gamma-Chlordane		63-141	25	79-138
Dieldrin		65-153	22	84-143
4,4'-DDD		72-151	24	80-145
4,4'-DDE		55-148	21	79-138
4,4'DDT		55-162	25	75-151
Endrin		61-156	21	79-139
Endosulfan sulfate		68-166	20	77-154
Endrin aldehyde		48-153	26	74-138
Endrin ketone		65-162	27	78-150
Endosulfan-I		56-143	21	78-135
Endosulfan-II		53-158	21	81-138
Heptachlor		52-145	24	73-134
Heptachlor epoxide		66-141	28	80-137
Methoxychlor		64-165	24	77-150
Toxaphene		50-150	10	50-150
Decachlorobiphenyl	15-142			
Tetrachloro-m-xylene	36-126			

TABLE 6

Quality Control Limits for Pesticides in Sediment, Method 8081A
Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate (% Rec)	MS/MSD (% Rec)	MS/MSD (% RPD)	Blank Spike (% Rec)
Aldrin		49-137	29	71-143
alpha-BHC		53-131	38	71-142
Beta-BHC		30-170	41	69-133
delta-BHC		27-158	40	65-141
gamma-BHC (Lindane)		35-148	29	71-141
alpha-Chlordane		50-143	39	72-141
gamma-Chlordane		49-142	29	73-143
Dieldrin		51-151	28	74-148
4,4'-DDD		50-154	32	70-149
4,4'-DDE		48-159	30	71-144
4,4'-DDT		20-193	42	67-155
Endrin		27-168	30	68-145
Endosulfan sulfate		45-138	33	67-143
Endrin aldehyde		31-120	32	40-120
Endrin ketone		23-172	41	70-142
Endosulfan-I		50-130	29	71-137
Endosulfan-II		53-133	37	71-138
Heptachlor		51-136	32	71-141
Heptachlor epoxide		28-162	31	71-141
Methoxychlor		28-179	41	64-149
Toxaphene		35-117	11	80-118
Decachlorobiphenyl	28-148			
Tetrachloro-m-xylene	31-136			

TABLE 7

Quality Control Limits for PCB's in Water, Method 8082

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate (% Rec)	MS/MSD (% Rec)	MS/MSD (% RPD)	Blank Spike (% Rec)
Aroclor-1016		58-140	14	71-131
Aroclor-1260		58-140	14	72-134
Decachlorobiphenyl	18-156			
Tetrachloro-m-xylene	38-133			

TABLE 8

Quality Control Limits for PCB's in Sediments, Method 8082

Quanta Resources OU2, Edgewater, NJ

Compound/Analyte	Surrogate (% Rec)	MS/MSD (% Rec)	MS/MSD (% RPD)	Blank Spike (% Rec)
Aroclor-1016		43-161	19	68-138
Aroclor-1260		37-164	24	66-136
Decachlorobiphenyl	40-151			
Tetrachloro-m-xylene	37-140			

TABLE 9

Quality Control Limits for Metals in Water and Sediments, Methods 6010B, 7470A, 7471A
Quanta Resources OU2, Edgewater, NJ

Analyte	MS (% Rec)	Duplicate (% RPD)	Blank Spike (% Rec)
All Analytes	75–125	< 20	80–120%
Aluminum			for all
Antimony			analytes
Arsenic			
Barium			
Beryllium			
Cadmium			
Calcium			
Chromium			
Cobalt			
Copper			
Iron			
Lead			
Magnesium			
Manganese			
Mercury			
Nickel			
Potassium			
Selenium			
Silver			
Sodium			
Thallium			
Vanadium			
Zinc			

TABLE 10

Quality Control Limits for PCB Congeners
Quanta Resources OU2, Edgewater, NJ

Analyte	OPR/LCS Accuracy Water/Sediment (% R)	MS/MSD Accuracy Water/Sediment (% R)	MS/MSD Precision Water/Sediment (% RPD)	Lab/Field Duplicate Precision Water/Sediment (% RPD)
All PCB Congeners	50–150	70–130	20	25

TABLE 11

Quality Control Limits for Radiochemistry Parameters
Quanta Resources OU2, Edgewater, NJ

Analyte	LCS Accuracy Water (% R)	Duplicate Accuracy Water (% R)	Precision Water (% RPD)	LCS Accuracy Sediment (% R)	Duplicate Accuracy Sediment (% R)	Precision Sediment (% RPD)
Cs-137	75–125	75–125	20	75–125	75–125	20

TABLE 12

Inorganic Target Analyte List and Reporting Limits
Quanta Resources OU2, Edgewater, NJ

Analyte	RL for Water (µg/L)	RL for Sediment (mg/kg)
1. Aluminum	200	20
2. Antimony	6	2
3. Arsenic	2	2
4. Barium	5	5
5. Beryllium	1	0.5
6. Cadmium	4	0.5
7. Calcium	200	20
8. Chromium	15	1.5
9. Cobalt	5	0.5
10. Copper	10	1
11. Iron	200	20
12. Lead	3	2
13. Magnesium	100	10
14. Manganese	5	0.5
15. Mercury	0.2	0.1
16. Nickel	10	1
17. Potassium	500	50
18. Selenium	20	2
19. Silver	5	0.5
20. Sodium	1000	100
21. Thallium	2	1
22. Vanadium	5	0.5
23. Zinc	20	2

TABLE 14
Target Compound List and Reporting Limits for PCB Congeners
Quanta Resources OU2, Edgewater, NJ

Analyte	Reporting Limits Water (pg/L)	Reporting Limits Sediment (pg/g)
1-MoCB	25	2.5
2-MoCB	25	2.5
3-MoCB	25	2.5
4/10-DiCB	50	5
7/9-DiCB	50	5
6-DiCB	50	5
5/8-DiCB	50	5
14-DiCB	50	5
11-DiCB	50	5
12,13-DiCB	50	5
15-DiCB	50	5
19-TrCB	25	2.5
18-TrCB	25	2.5
30-TrCB	25	2.5
17-TrCB	25	2.5
24/27-TrCB	25	2.5
16/32-TrCB	25	2.5
34-TrCB	25	2.5
23-TrCB	25	2.5
26-TrCB	25	2.5
29-TrCB	25	2.5
25-TrCB	25	2.5
31-TrCB	25	2.5
28-TrCB	25	2.5
20,21,33-TrCB	25	2.5
22-TrCB	25	2.5
36-TrCB	25	2.5
39-TrCB	25	2.5
38-TrCB	25	2.5

TABLE 14
Target Compound List and Reporting Limits for PCB Congeners
Quanta Resources OU2, Edgewater, NJ

Analyte	Reporting Limits Water (pg/L)	Reporting Limits Sediment (pg/g)
35-TrCB	25	2.5
37-TrCB	25	2.5
54-TeCB	50	5
50TeCB	50	5
53-TeCB	50	5
45-TeCB	50	5
51-TeCB	50	5
46-TeCB	50	5
52/69-TeCB	50	5
73-TeCB	50	5
43/49-TeCB	50	5
48/75-TeCB	50	5
44-TeCB	50	5
47-TeCB	50	5
65-TeCB	50	5
42/59TeCB	50	5
62-TeCB	50	5
41/64/71/72-TeCB	50	5
40-TeCB	50	5
68-TeCB	50	5
57-TeCB	50	5
58-TeCB	50	5
67-TeCB	50	5
63-TeCB	50	5
61-TeCB	50	5
70-TeCB	50	5
74-TeCB	50	5
76-TeCB	50	5
66-TeCB	50	5
55-TeCB	50	5

TABLE 14
Target Compound List and Reporting Limits for PCB Congeners
Quanta Resources OU2, Edgewater, NJ

Analyte	Reporting Limits Water (pg/L)	Reporting Limits Sediment (pg/g)
56/60-TeCB	50	5
80-TeCB	50	5
79-TeCB	50	5
78-TeCB	50	5
81-TeCB	50	5
77-TeCB	50	5
104-PeCB	50	5
96-PeCB	50	5
103-PeCB	50	5
94-PeCB	50	5
95/98/102-PeCB	50	5
93-PeCB	50	5
100-PeCB	50	5
88,91-PeCB	50	5
84/92-PeCB	50	5
89-PeCB	50	5
121-PeCB	50	5
90,101-PeCB	50	5
113-PeCB	50	5
83-PeCB	50	5
99-PeCB	50	5
108/112-PeCB	50	5
86-PeCB	50	5
87/117/125-PeCB	50	5
97-PeCB	50	5
119-PeCB	50	5
124-PeCB	50	5
85,116-PeCB	50	5
110-PeCB	50	5
82-PeCB	50	5

TABLE 14
Target Compound List and Reporting Limits for PCB Congeners
Quanta Resources OU2, Edgewater, NJ

Analyte	Reporting Limits Water (pg/L)	Reporting Limits Sediment (pg/g)
111/115-PeCB	50	5
120-PeCB	50	5
107/109-PeCB	50	5
123-PeCB	50	5
106/118-PeCB	50	5
122-PeCB	50	5
114-PeCB	50	5
105-PeCB	50	5
127-PeCB	50	5
126-PeCB	50	5
155-HxCB	50	5
152-HxCB	50	5
150-HxCB	50	5
136-HxCB	50	5
145-HxCB	50	5
148-HxCB	50	5
135-HxCB	50	5
151-HxCB	50	5
154-HxCB	50	5
144-HxCB	50	5
147-HxCB	50	5
133/143-HxCB	50	5
139,149-HxCB	50	5
131-HxCB	50	5
140-HxCB	50	5
134/142-HxCB	50	5
132/161-HxCB	50	5
146/165-HxCB	50	5
153-HxCB	50	5
168-HxCB	50	5

TABLE 14

Target Compound List and Reporting Limits for PCB Congeners
Quanta Resources OU2, Edgewater, NJ

Analyte	Reporting Limits Water (pg/L)	Reporting Limits Sediment (pg/g)
141-HxCB	50	5
130-HxCB	50	5
137-HxCB	50	5
138/163/164-HxCB	50	5
129-HxCB	50	5
158/160-HxCB	50	5
128,162-HxCB	50	5
159-HxCB	50	5
166-HxCB	50	5
167-HxCB	50	5
156-HxCB	50	5
157-HxCB	50	5
169-HxCB	50	5
188-HpCB	50	5
179-HpCB	50	5
184-HpCB	50	5
176-HpCB	50	5
186-HpCB	50	5
178-HpCB	50	5
175-HpCB	50	5
182/187-HpCB	50	5
183-HpCB	50	5
185-HpCB	50	5
174-HpCB	50	5
177-HpCB	50	5
181-HpCB	50	5
171-HpCB	50	5
173-HpCB	50	5
172-HpCB	50	5
192-HpCB	50	5

TABLE 14
Target Compound List and Reporting Limits for PCB Congeners
Quanta Resources OU2, Edgewater, NJ

Analyte	Reporting Limits Water (pg/L)	Reporting Limits Sediment (pg/g)
180-HpCB	50	5
193-HpCB	50	5
191-HpCB	50	5
170-HpCB	50	5
190-HpCB	50	5
189-HpCB	50	5
202-OcCB	50	5
201-OcCB	50	5
204-OcCB	50	5
197-OcCB	50	5
200-OcCB	50	5
198,199-OcCB	50	5
196/203-OcCB	50	5
195-OcCB	50	5
194-OcCB	50	5
205-OcCB	50	5
208-NoCB	50	5
207-NoCB	50	5
206-NoCB	50	5
209-DeCB	50	5

pg/L = picograms per liter
pg/g = picograms per gram

TABLE 15

Target Compound List and Reporting Limits for Radiochemistry Parameters

Quanta Resources OU2, Edgewater, NJ

Analyte	Reporting Limits Water (pCi/L)	Reporting Limits Sediment (pCi/g)
¹³⁷ Cs	10	0.5

pCi/L = picocuries per liter
pCi/g = picocuries per gram

TABLE 16

Required Analytical Method, Sample Containers, Preservation, and Holding Times
Quanta Resources OU2, Edgewater, NJ

Analyses	Analytical Method	Sample Matrix ^a	Container ^b	Qty	Preservative ^c	Holding Time ^d
Volatile Organic Compounds	SW-846 8260B	W	40-mL, glass	3	HCl, pH<2; cool to 4 °C	14 days
	SW-846 8260B	S	5 g—Encore or equivalent sampling technique	3	Cool 4°C	14 days
TCLP—Volatile Organic Compounds	SW-846 1311/8260B	S	8-oz glass	1	Cool 4°C	14/7 days
Semivolatile Organic Compounds / PAHs	SW-846 8270C / 8270C SIM	W	1-L amber glass	2	Cool 4°C	7/40 days ^f
	SW-846 8270C	S	8-oz glass	1	Cool 4°C	14/40 days ^g
TCLP—Semivolatile Organic Compounds	SW-846 1311/8270C/8270 CSIM	S	8-oz glass	1	Cool 4°C	14/7/40 days ^h
Organochlorine Pesticides	SW-846 3510C/3520C/ 8081A	W	1-L amber glass	2	Cool 4°C	7/40 days ^f
	SW-846 3550B/8081A Cleanup—3620B	S	8-oz glass	1	Cool 4°C	14/40 days ^g
TCLP—Organochlorine Pesticides	SW-846 1311/8081A	S	8-oz glass	1	Cool 4°C	14/7/40 days ^h
Polychlorinated Biphenyls	SW-846 8082	W	1-L amber glass	2	Cool 4°C	7/40 days ^f
	SW-846 8082	S	8-oz glass	1	Cool 4°C	14/40 days ^g
PCB Congeners	EPA 1668	W	1-L amber glass	2	Cool 4°C	7/40 days ^f
	EPA 1668	S	4-oz glass	1	Cool 4°C	14/40 days ^g
Radio Isotopes (Cesium-137)	Gamma Spectrometry	W	glass or polyethylene	1	HNO ₃ , pH < 2	6 months
	Gamma Spectrometry	S	glass or polyethylene	1	N/A	6 months

TABLE 16

Required Analytical Method, Sample Containers, Preservation, and Holding Times
Quanta Resources OU2, Edgewater, NJ

Analyses	Analytical Method	Sample Matrix ^a	Container ^b	Qty	Preservative ^c	Holding Time ^d
Metals (Total)	SW-846 SW6010B /7000 Series	W	500-mL polyethylene	1	HNO ₃ , pH < 2 Cool 4°C	6 months
	SW-846 SW6010B /7000 Series	S	8-oz glass	1	Cool 4°C,	6 months
TCLP-Metals (Total)	SW-846 1311/6010 /7000 Series	S	8-oz glass	1	Cool 4°C,	6 months
Mercury	SW-846 7470A	W	500-mL polyethylene	1	HNO ₃ , pH < 2 Cool 4°C	28 days
	SW-846 7471A	S	8-oz glass	1	Cool 4°C,	28 days
TCLP-Mercury	SW-846 1311/7471A	S	8-oz glass	1	Cool 4°C	28 days
Total Organ Carbon	SW-846 9060	W	250-mL polyethylene	1	H ₂ SO ₄ or HCl pH < 2, Cool 4°C	28 days
		S	4-oz glass	1	Cool 4°C	28 days
Redox potential	ASTM D1498-93	W	Field, 250-mL glass	1	None	As soon as possible
		S	4-oz glass	1		
Bulk Density	ASTM D-2937	S	Brass Sleeve (known volume)	1	None	NA
Specific Gravity	ASTM D-854	S	500 g glass	1	None	NA
Percent Moisture	ASTM D2216	S	500 g glass	1	None	NA
Organic Content	ASTM D2974	S	500 g glass	1	None	NA
Atterberg Limits	ASTM D4318	S	500 g glass	1	None	NA
Consolidation	ASTM D2435	S	500 g glass	1	None	NA
Permeability	ASTM D2434	S	500 g glass	1	None	NA
Shear Strength		S	500 g glass	1	None	NA
Grain Size	ASTM D-422	S	500 g glass	1	None	NA

TABLE 16

Required Analytical Method, Sample Containers, Preservation, and Holding Times
 Quanta Resources OU2, Edgewater, NJ

Analyses	Analytical Method	Sample Matrix ^a	Container ^b	Qty	Preservative ^c	Holding Time ^d
----------	-------------------	----------------------------	------------------------	-----	---------------------------	---------------------------

Notes: Source—SW-846, third edition, Update III (June 1997).

Sample container, and volume requirements will be specified by the analytical laboratory performing the tests. Three times the required volume should be collected for samples designated as MS/MSD samples.

^a Sample matrix: S = surface soil, subsurface soil, sediment; W = surface water

^b All containers will be sealed with Teflon®-lined screw caps.

^c All samples will be stored promptly at 4°C in an insulated chest.

^d Holding times are from the time of sample collection.

^e 14 days to TCLP extraction, 7 days for extraction, 40 days for analysis

^f 7 days to extraction for water, 40 days for analysis.

^g 14 days to extraction for soil, 40 days for analysis.

^h 14 days to TCLP extraction for soil, 40 days for analysis

ⁱ 30 days to extraction for water, 45 days for analysis.

^j Reactivity, Corrosivity, and Ignitability can be obtained from the same container

°C = Degrees Centigrade

HCl = Hydrochloric acid

TCLP = Toxicity characteristic leaching procedure

mL = Milliliter

g = Gram

L = Liter

oz = Ounce

TPH = Total petroleum hydrocarbon

NaOH = Sodium hydroxide

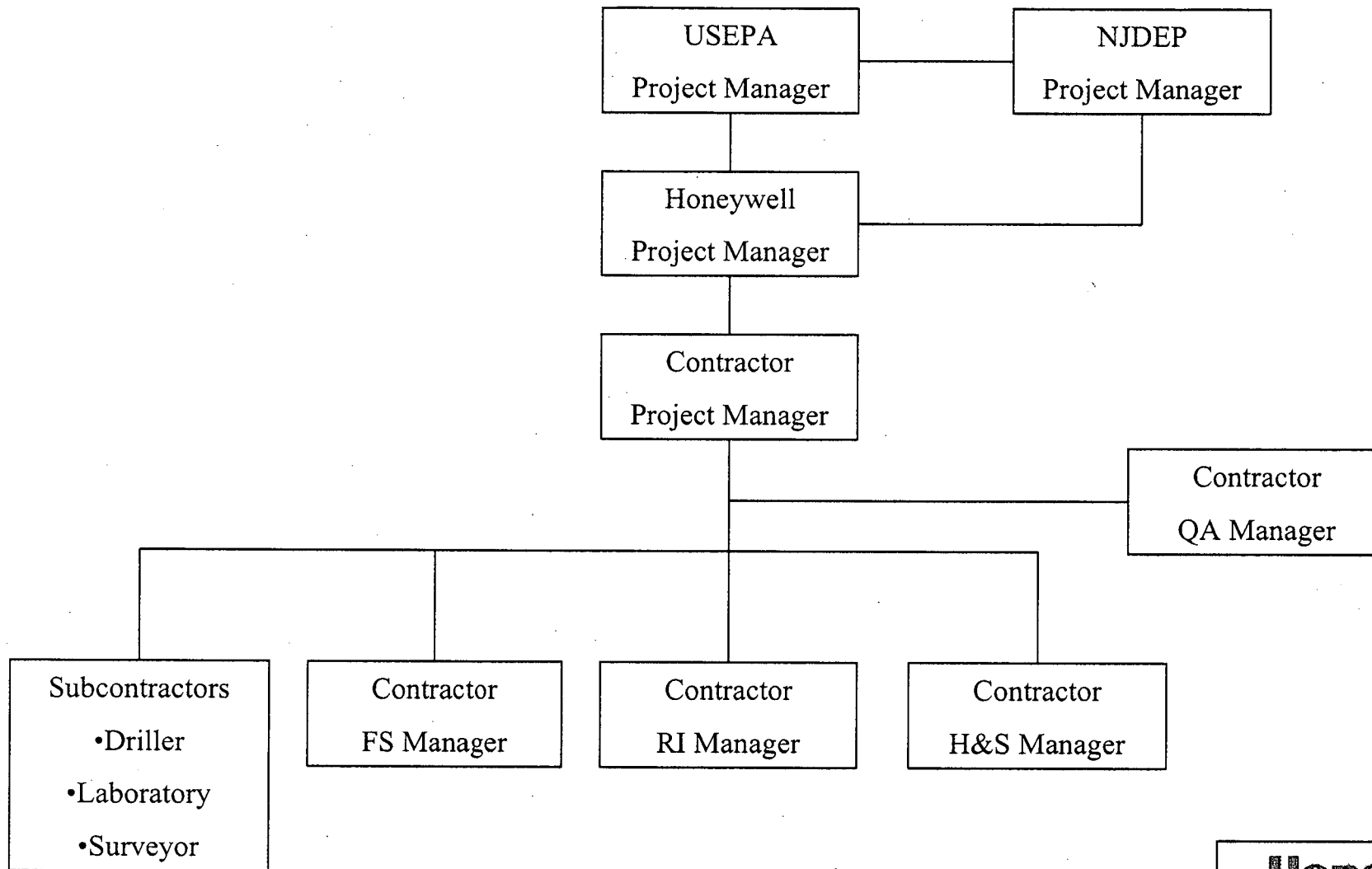
HNO₃ = Nitric acid

EPA = U.S. Environmental Protection Agency

H₂SO₄ = Sulfuric acid

ASTM = American Society for Testing and Materials

NA = Not applicable



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PARSONS

Quanta Resources RI/FS
Edgewater, NJ

Figure 1-1
Organizational Chart
For Communication

PRIMARY SOURCES

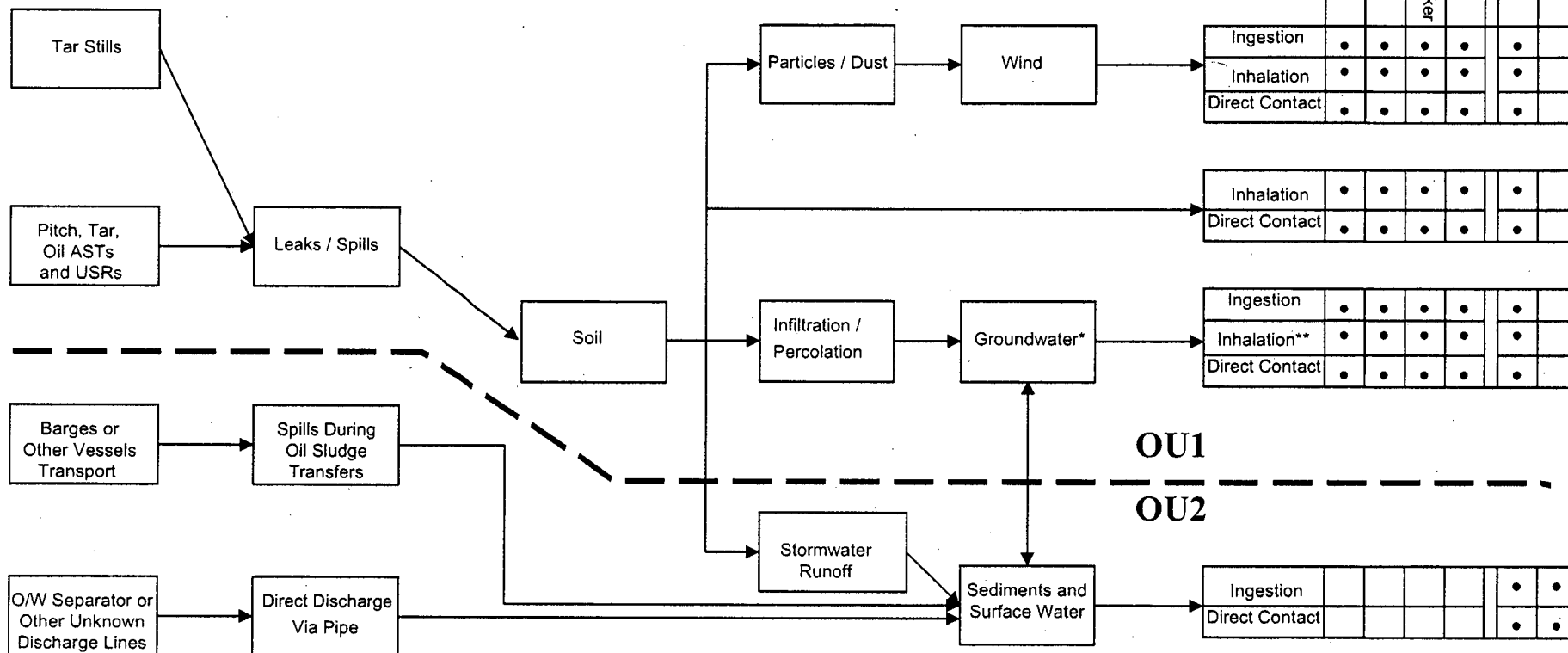
PRIMARY RELEASE MECHANISMS

SECONDARY SOURCES

SECONDARY RELEASE MECHANISMS

PATHWAY

RECEPTOR



Notes:

* Includes movement of ground through underground utilities.

** The inhalation receptor category for ground water is from volatilization of contaminants from ground water into soil vapor and eventually into indoor air.

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PARSONS

Quanta Resources RI/FS
Edgewater, NJ

Figure 1-2
Conceptual Site Model

Appendix C

Health and Safety Plan, Operable Unit 2 Quanta Resources Site Edgewater, New Jersey

Prepared for
Honeywell International, Inc.

101 Columbia Road
P.O. Box 2105
Morristown, NJ 07962

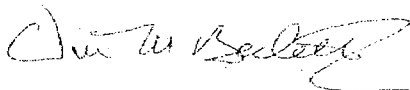
August 2006

Prepared by
Parsons
150 Federal Street, 4th Floor
Boston, MA 02110

Revised by
CH2MHILL
1700 Market Street, Suite 1600
Philadelphia, PA 19103

Reviewed and Approved By:

Honeywell
Program or
Project Health and
Safety Manager



Date: 8/14/2006

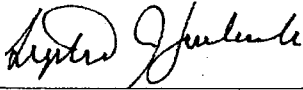
HEALTH AND SAFETY PLAN
Honeywell - Quanta Resources - Former Allied Signal Facility
Operating Unit #2 Work Area
163 River Road
Edgewater, New Jersey

PHONE

Project Number:	332898	
Project Manager:	Steve Zarlinski/PHL	215-563-4220x319
Task manager	Andrew Hopton/PHL	215-563-4220 x340
Safety Coordinator (SC)	Jennifer Simms/PHL	215-563-4220 x341
Honeywell Program H&S Manager	Bill Berlett/CHI	773-693-3800 x316 847-770-0209 (cell)
Project H&S Manager	Bill Berlett	773-693-3800 x316 847-770-0209 (cell)
Preparation Date:	August 14, 2006	
Expiration Date:	August 14, 2007	

APPROVALS

Project Manager:



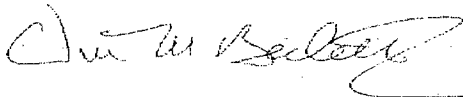
August 30, 2006
(DATE)

Safety Coordinator



August 30, 2006
(DATE)

Honeywell Program or Project Health and Safety Manager:



August 25, 2006
(DATE)

CIH/CSP

This Health and Safety Plan is valid only for this specific project as described in Section 3.0. It is not to be used for other projects or subsequent phases of this project without the written approval of the Honeywell Program Health and Safety Manager. A copy of this plan is to be maintained at the site at all times.

INTRODUCTION - SITE BACKGROUND

This Health, Safety and Environment Plan (HS&E Plan) will be kept on the site during all field operations and field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Health, Safety, and Environmental Protection (HS&E) Program Manual*. In addition, this plan adopts procedures in the project Work Plan and incorporates applicable elements of Honeywell's HS&E requirements. The Safety Coordinator (SC) is to be familiar with the SOPs contained in the HS&E Program Manual and the contents of this plan.

CH2M HILL personnel and subcontractors must sign the CH2M HILL Employee Sign-Off Form included in Attachment 1 after reading/reviewing this HS&E Plan.

SITE DESCRIPTION AND HISTORY: The site is currently vacant and contains numerous exposed concrete tank and building foundations, a former oil/water separator, a wood bulkhead, and wooden docks along the Hudson River. The Quanta site was formerly occupied by Allied Chemical beginning the 1930s. Allied Chemical used the site for tar processing. The three main products that were processed onsite were creosote, coal tar pitches, and refined tars for roads. After the sale of the site it was leased by E.R.P. Corporation who recycled and stored oil. Quanta Resources Corporation took over the site in 1980. At that time the site contained 61 aboveground storage tanks with a capacity of 9 million gallons along with at least 10 underground storage tanks and underground pipes. The site has been unoccupied since 1981 when the New Jersey Department of Environmental Protection ceased Quanta's operations after it was discovered that polychlorinated biphenyls were present in some of the oil stored onsite at concentrations as high as 260 parts per million.

The upland part of the site (OU1) is backfilled with 10 or more feet of non-native fill and has a wooden pile bulkhead along the shoreline. The offshore portion (OU2) includes intertidal and shallow subtidal sediments.

Existing data for OU2 indicate that NAPL occurs as lenses interbedded with silt, and that concentrations of polynuclear aromatic hydrocarbons (PAHs) in sediment are elevated in areas where NAPL is found. Concentrations of other chemicals appear to be either generally uniformly distributed, or highest adjacent to the bulkhead. Elevated concentrations of several chemicals were also found in sediment to the north of the Quanta Resources site, adjacent to the former Lustrelon property. The extent of NAPL in OU2 was delineated in 1999 using CPT/ROST technology. This method, while the best available technology at the time, was not capable of differentiating various types of petroleum products or providing a detailed and refined interpretation of coal tar distribution. In addition to contaminants from the Quanta Resources site, OU2 sediments may be affected by urban runoff and upstream and/or downstream sources of contamination. A remedial investigation (RI) of OU2 is required to:

- Determine the lateral and vertical distribution and extent of potential chemicals of interest (PCOIs) associated with releases from the Quanta Resources site
- More accurately delineate the extent of coal tar in sediment
- Characterize the depositional environment adjacent to the site
- Characterize potential ecological and human health risks associated with exposure to contaminants from the site
- Obtain information to evaluate the most feasible options for managing sediments.

OU2 field work will include sediment sampling from a boat or barge with a vibracore sampler and surface water sampling. There will also be a TarGOST survey conducted which involves geoprobing from a boat or barge.

Emergency Contacts

24-hour CH2M HILL Emergency Beeper - 720-286-4911

Medical Emergency - 911

Fire/Spill Emergency - 911

Security & Police - 911

Local Facility Emergency Response
Number:

CH2M HILL Medical Consultant

Health Resources

Dr. Jerry H. Berke, M.D., M.P.H.

600 West Cummings Park, Suite 3400

Woburn, MA 01801-6350

1-781-938-4653 (8 am to 11 pm EST)

1-800-350-4511 (after hours and on weekends)

(After hours calls will be returned within 20 minutes)

Honeywell Health, Safety & Environment Program Manager (PHSM)

Name: Bill Berlett/CHI

Phone: 773-693-3800 x 316

Cell: 847-770-0209

Fax: 773-693-3823

Environmental Compliance Coordinator (ECC)

Name: Linda Hickok/SYR

Phone: (315) 422-7250 x229

Project Health & Safety Manager (HSM)

Name: Bill Berlett/CHI

Phone: 773-693-3800 x 316

Cell: 847-770-0209

Fax: 773-693-3823

Safety Coordinator (SC)

Name: Jennifer Simms/PHL

Phone: 215-563-4220 x341

Project Manager (PM)

Steve Zarlinski

Phone: 215-563-4220 x319

Regional Human Resources Department (Workers' Compensation Contact)

Name: Cindy Bauder/WDC

Phone: 703/471-6405 ext. 4243

Federal Express Dangerous Goods Shipping

Phone: 800/238-5355

Worker's Compensation:

Contact Regional HR dept. to have form completed or
contact Albert Jerman after hours: 303-741-5927

CH2M HILL Emergency Number for Shipping Dangerous Goods

Phone: 800/255-3924

Automobile Accidents:

Rental: Linda Anderson/DEN 720-286-2401

CH2M HILL owned vehicle:

Zurich Insurance Co. 800-987-3373

Contact the PM. Generally, the PM will contact relevant government agencies.

Facility Alarms: N/A

Evacuation Assembly Area(s): TBD by SC

Facility/Site Evacuation Route(s): TBD by SC

Hospital: Palisades General Hospital

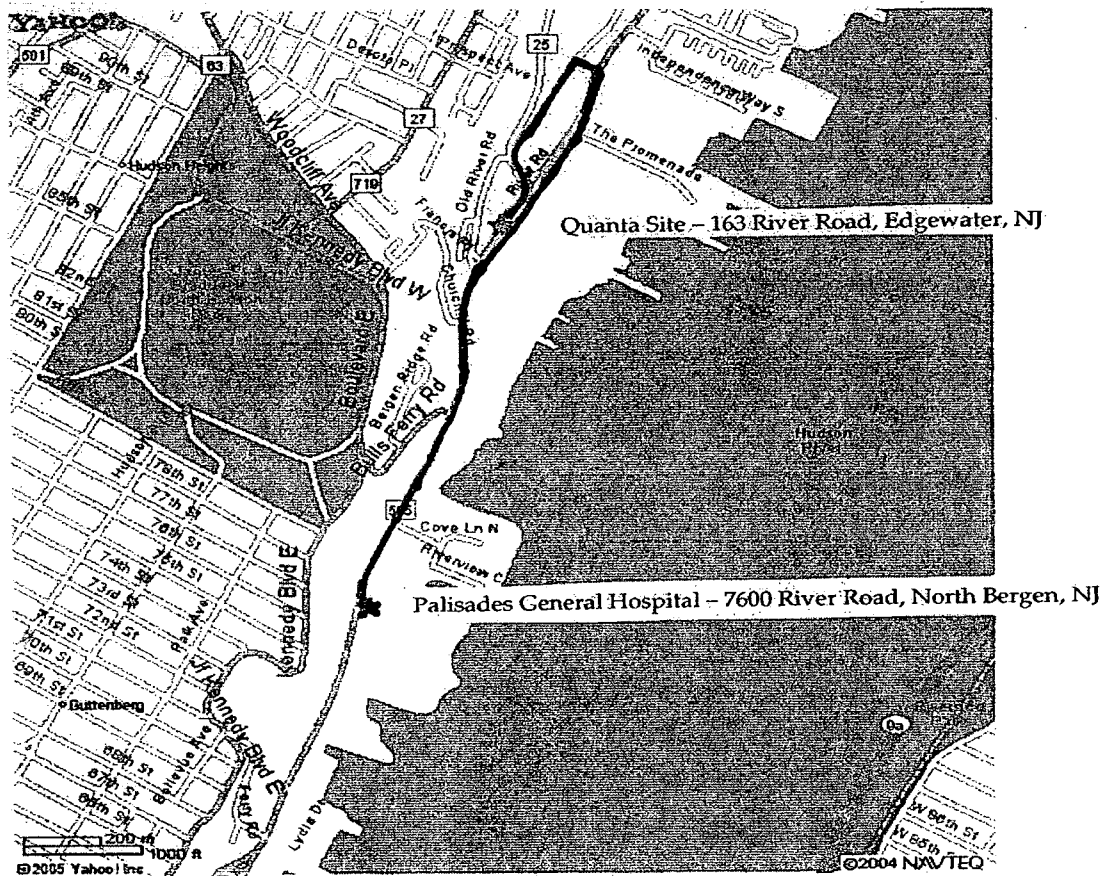
7600 River Road

North Bergen, New Jersey

Hosp. Phone #: (201) 854- 5000

Directions to Hospital

Hospital Route Map



- 1.) Head northeast from River Road
- 2.) Turn left at Gorge Road - go 0.1 mile
- 3.) Turn right at Old River Road - go 0.2 mile
- 4.) Turn right and head toward River Road
- 5.) Turn right at River Road - go 1.1 mile
- 6.) Make left turn into Palisades General Hospital

Change Management Form

Honeywell Project HS&E Change Management Form

*This evaluation form should be reviewed on a **continuous** basis to determine if the current site health and safety plan adequately addresses ongoing project work, and should be completed whenever new tasks are contemplated or changed conditions are encountered..*

Project Task: OU2 field work will include sediment sampling from a boat or barge with a vibracore sampler and surface water sampling. There will also be a TarGOST survey conducted which involves geoprobing from a boat or barge.

Project Number: 332898

Project/Task Manager: **Steve Zarlinski**

Name: **Quanta Resources - Edgewater,
New Jersey**

Safety Coordinator **Jennifer Simms**

Evaluation Checklist


Yes No

1.	Have the CH2MHILL staff listed in the original HSP/FSI changed?		
2.	Has a new subcontractor been added to the project?		
3.	Is any chemical or product to be used that is not listed in Attachment 2 of the plan?		
4.	Have additional tasks been added to the project, which were not originally addressed in the plan?		
5.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6.	Have other safety, equipment, activity or environmental hazards been encountered that are not addressed in the plan?		

If the answer is "YES" to Question 3, an HSP/FSI revision is NOT needed. Please take the following actions:

- ♦ Add the chemical to Attachment 2, and ensure employees handling the chemical are trained, and training documentation is added to Attachment 3.

If the answer is "YES" to Questions 1, 2 or 4-6, an HSP/FSI revision MAY BE NEEDED. Please contact Bill Berlett (773-693-3800 x316) directly.



Site Map

This page is reserved for a Site Map.

Note locations of Support, Decontamination, and Exclusion Zones; site telephone; first aid station; evacuation routes; and assembly areas.

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1 Tasks to be Performed Under this HS&E Plan

1.1 Description of Tasks

(Reference Field Project Start-up Form)

Refer to project documents (i.e., Work Plan) for detailed task information. A task hazard analysis has been performed for each task and is included below while project-specific hazard controls are provided in the next section. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Hazwoper Compliance Plan Section of this HS&E Plan for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (Hazwoper).

1.1.1 Hazwoper-Regulated Tasks

OU2 major field work tasks will include sediment sampling from a boat or barge with a vibracore sampler and surface water sampling. There will also be a TarGOST survey conducted which involves geoprobing from a boat or barge.

1.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. The following tasks are considered non-hazardous.

Site Visits from management personnel or regulatory agencies, personnel on site for meetings, drivers delivery materials for project within the support zone, etc.

1.1.3 Environmental-Regulated Tasks and Conditions

Project tasks and site conditions that can impact the environment and are otherwise subject to environmental regulation are included in Section 1.3. These items are also known as the environmental aspects of the project (activities that can interact with the environment). Environmental impacts relating to each task or condition are also presented in Section 1.3, which is used to evaluate the project's significant impacts and control measures specified in Hazard Controls and Safe Work Practices section of this HS&E Plan.

All personnel shall: (1) implement control measures described in Hazard Control Section; (2) obtain appropriate environmental training (e.g., Waste Management or Dangerous Goods Shipping) and (3) seek assistance from the regional Environmental Compliance Coordinator (ECC) for all environmental questions or issues.

1.1.4 Honeywell Permit Required Tasks

There are no Honeywell permits required for this project.

TASKS

PERMITS ISSUES BY

N/A

1.2 Task Hazard Analysis

TASKS	POTENTIAL HAZARDS (Refer to Hazard Control Section for additional information)																												
	Aerial Lifts	Back Injury (Bending/ Lifting)	Biological Hazards	Buried Utilities	Cold Stress	Confined Space Entry	Electrical	Elevated Work Areas/ Falls	Entanglement	Excavations	Fires	Flying Debris/ Objects	Gas Cylinders	Hand and Power Tools	Heat Stress	Heavy Equipment Exposure	Ionizing Radiation	Lockout-Tagout	Noise	Radio-Frequency Radiation	Respiratory Protection	Slips, Trips and Falls	Stairways and Ladders	Suspended Loads	Traffic Exposure	Vehicle Backing Exposure	Visible Lightning	Working Above or Near Water	
Geoprobe drilling on a boat/ barge for sediment and water samples		X	X						X			X		X	X				X			X					X	X	X
Surface water and sediment sampling using a boat		X	X						X			X		X	X				X			X							X
IDW drum sampling and disposal		X	X											X	X							X							

1.3 Environmental Impacts

(Refer to the Hazard Control Section for control measures)

Tasks/Conditions	Impacts						
	Air Pollution	Land Pollution	Land Disposal	Noise Pollution	Water Pollution	Resource Depletion	Human Hazard
Coastal and Wetland Resources Disturbed		X			X		X
Protected Species or Habitat Disturbed		X			X		X
Waste (Haz/Non-Haz) Mgmt, Transport and Disposal	X	X	X		X		X

2 Hazard Controls and Safe Work Practices

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the SC for clarification. In addition to the hazard controls specified in this section, the following are required for Honeywell projects.

2.1 Administrative Controls

HS&E Plans: CH2M HILL requires HS&E plans for all field projects and subcontractors are required to submit detailed Job Hazard Analysis for their activities as well. The HS&E plan provides a risk analysis of each task and identifies the potential hazards and control measures (including personal protective equipment and air monitoring requirements) for each task.

Job Hazard Analysis (JHAs): JHAs are required by CH2M HILL for all tasks unless the HSM specifically determines it is unnecessary. JHAs provide a step-by-step analysis of the activity being performed and identifies the equipment and control measures necessary to conduct the work safely. JHAs must be reviewed by the work team immediately prior to conducting the work. The JHAs can be a source of information for the daily safety meeting. Copies of JHAs are provided in Attachment 2. Contractors and subcontractors must develop JHAs for their site activities; these must be reviewed by the HSM prior to initiating site activities.

Safety Meetings: CH2M HILL requires that the safety coordinator conduct daily safety meetings to discuss with the field team the task to be performed that day and the potential hazards and mitigation measure. The safety meeting can be used to review the JHA with the team. The Pre Task Safety Plan (PTSP) must be developed each day prior to performing specific work tasks. Each member of the team performing the task must be included in the planning so all are aware of the task hazards and controls. A copy of a PTSP is included in Attachment 11.

Self-Assessments: Project Activity Self-Assessment Checklists are contained in Attachment 3. These checklists provide a method of verifying compliance with established safe work practices, regulations, and industry standards pertaining to hazardous activities. The checklists can be used by any CH2M HILL employee who may be exposed to a hazardous activity or by the SC when providing oversight of a subcontractor performing a hazardous activity. Self-assessments shall be completed prior to subjecting CH2M HILL staff to hazardous operations for any reason. Self-assessment checklists should be completed daily for the first week or until such time that the contractor is exhibiting appropriate work methods, then on a weekly basis thereafter.

If hazardous conditions exist or are apparent during the self-assessment, immediately notify the employees in the area and do not continue work in that area until the conditions are safe. If an imminent danger situation (immediately life threatening or would cause serious injury) exists, immediately stop work, warn all personnel in danger and notify the appropriate safety representative and the CH2M HILL SC. Non-compliance issues identified during the self-assessment shall be immediately rectified. If corrective action assistance is required, the HSM should be contacted for guidance.

Any site-specific requirements outlined in this HS&E Plan that are more stringent than those contained in the self-assessment checklists are to take precedence. The self-assessment checklists are based upon minimum regulatory compliance and some site-specific requirements may be more stringent. The self-

assessment checklists, including documented corrective actions, shall be made part of the permanent project records and maintained by the SC.

Site Compliance/Audits:

In order to ensure compliance with requirements contained in the RES H&S Manual, Specification 01620, and with this HASP, audits will be conducted by a HS&E professional as follows: The project should be audited at least once during the duration of the field activities.

Interventions: Honeywell requires that we intervene whenever we see someone exhibiting an unsafe behavior or working in unsafe conditions. When such a situation is observed, an intervention is performed by talking to the person about how the task could be done more safely. Safe Work Observation forms must be completed on a weekly basis, at a minimum, by the SC or FTL. Each completed form must be maintained with the HASP field documents, then transferred to project files upon the completion of the field work. A copy of a Safe Work Observation form is included in Attachment 11.

2.2 General Hazards and Controls

2.2.1 General Practices and Housekeeping

(Reference CH2M HILL SOP HS-209, *General Practices*)

- Site work should be performed during daylight hours whenever possible. Work conducted during hours of darkness require enough illumination intensity to read a newspaper without difficulty.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.

2.2.2 Hazard Communication

(Reference CH2M HILL SOP HS-107, *Hazard Communication*)

The SC is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 4.
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.
- Copies of all applicable MSDSs will be placed in Attachment 5.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 6.

- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

2.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's *Procedures for Shipping and Transporting Dangerous Goods*)

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the HSM or the Equipment Coordinator for additional information.

2.2.4 Lifting

(Reference CH2M HILL SOP HS-112, *Lifting*)

- Proper lifting techniques must be used when lifting any object.
 - Plan storage and staging to minimize lifting or carrying distances.
 - Split heavy loads into smaller loads.
 - Use mechanical lifting aids whenever possible.
 - Have someone assist with the lift -- especially for heavy or awkward loads.
 - Make sure the path of travel is clear prior to the lift.

2.2.5 Fire Prevention

(Reference CH2M HILL SOP HS-208, *Fire Prevention*)

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet. When 5 gallons or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet. Extinguishers must:
 - be maintained in a fully charged and operable condition,
 - be visually inspected each month, and
 - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Post "Exit" signs over exiting doors, and post "Fire Extinguisher" signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

2.2.6 Electrical

(Reference CH2M HILL SOP HS-206, *Electrical*)

- Only qualified personnel are permitted to work on unprotected energized electrical systems.
- Only authorized personnel are permitted to enter high-voltage areas.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service.
- All temporary wiring, including extension cords and electrical power tools, must have ground fault circuit interrupters (GFCIs) installed.
- Extension cords must be:
 - equipped with third-wire grounding.
 - covered, elevated, or protected from damage when passing through work areas.
 - protected from pinching if routed through doorways.

- not fastened with staples, hung from nails, or suspended with wire.
- Electrical power tools and equipment must be effectively grounded or double-insulated UL approved.
- Operate and maintain electric power tools and equipment according to manufacturers' instructions.
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet from overhead power lines for voltages of 50 kV or less, and 10 feet plus ½ inch for every 1 kV over 50 kV.
- Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

2.2.7 Stairways and Ladders

(Reference CH2M HILL SOP HS-214, *Stairways and Ladders*)

- Stairway or ladder is generally required when a break in elevation of 19 inches or greater exists.
- Personnel should avoid using both hands to carry objects while on stairways; if unavoidable, use extra precautions.
- Personnel must not use pan and skeleton metal stairs until permanent or temporary treads and landings are provided the full width and depth of each step and landing.
- Ladders must be inspected by a competent person for visible defects prior to each day's use. Defective ladders must be tagged and removed from service.
- Ladders must be used only for the purpose for which they were designed and shall not be loaded beyond their rated capacity.
- Only one person at a time shall climb on or work from an individual ladder.
- User must face the ladder when climbing; keep belt buckle between side rails
- Ladders shall not be moved, shifted, or extended while in use.
- User must use both hands to climb; use rope to raise and lower equipment and materials
- Straight and extension ladders must be tied off to prevent displacement
- Ladders that may be displaced by work activities or traffic must be secured or barricaded
- Portable ladders must extend at least 3 feet above landing surface
- Straight and extension ladders must be positioned at such an angle that the ladder base to the wall is one-fourth of the working length of the ladder
- Stepladders are to be used in the fully opened and locked position
- Users are not to stand on the top two steps of a stepladder; nor are users to sit on top or straddle a stepladder
- Fixed ladders \geq 24 feet in height must be provided with fall protection devices.
- Fall protection should be considered when working from extension, straight, or fixed ladders greater than six feet from lower levels and both hands are needed to perform the work, or when reaching or working outside of the plane of ladder side rails.

2.2.8 Heat Stress

(Reference CH2M HILL SOP HS-211, *Heat and Cold Stress*)

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.

- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should consult the SC to avoid progression of heat-related illness.

SYMPTOMS AND TREATMENT OF HEAT STRESS					
	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool-but not cold-water. Call ambulance, and get medical attention immediately!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

2.2.9 Cold Stress

(Reference CH2M HILL SOP HS-211, *Heat and Cold Stress*)

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level

of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.

- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, hypothermia should consult the SC to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS			
	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm-but not hot-water. Have victim drink warm fluids, but not coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but not coffee or alcohol. Get medical attention.

2.2.10 Compressed Gas Cylinders

- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured in an upright position at all times.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.

2.2.11 Procedures for Locating Buried Utilities

Not anticipated during the OU2 site activities.

Local Utility Mark-Out Service

Name:

Phone:

- Where available, obtain utility diagrams for the facility.
- Review locations of sanitary and storm sewers, electrical conduits, water supply lines, natural gas lines, and fuel tanks and lines.
- Review proposed locations of intrusive work with facility personnel knowledgeable of locations of utilities. Check locations against information from utility mark-out service.

- Where necessary (e.g., uncertainty about utility locations), excavation or drilling of the upper depth interval should be performed manually
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon).
- When the client or other onsite party is responsible for determining the presence and locations of buried utilities, the SSC should confirm that arrangement.

2.2.12 Confined Space Entry

(Reference CH2M HILL SOP HS-203, *Confined Space Entry*)

No confined space entry will be permitted. Confined space entry requires additional health and safety procedures, training, and a permit. If conditions change such that confined-space entry is necessary, contact the HSM to develop the required entry permit.

When planned activities will not include confined-space entry, permit-required confined spaces accessible to CH2M HILL personnel are to be identified before the task begins. The SSC is to confirm that permit spaces are properly posted or that employees are informed of their locations and hazards.

2.2.13 Backing Field Vehicles

The following precautions shall be implemented to prevent incidents during backing of field vehicles:

- Avoid backing whenever possible. The SC will be responsible for determining when "backing" is allowed. If extensive backing is required, alarms that sense when an object is close by must be used.
- If backing is required, there MUST BE a spotter. If a spotter is not available, the driver MUST walk completely around the vehicle before backing up.
- When "backing" is likely to be a part of the activities, it must be discussed in the daily safety briefings to remind staff of the hazards and controls.
- Learn your vehicle's blind spots.

2.2.14 Driving in Areas with Tall Grass/Brush

Driving in areas with tall grass/brush can present a potential fire hazard if the grass/brush gets caught under and/or remains in contact with the vehicle exhaust system. Employees should exercise the following precautions:

- When stopping vehicle, ensure it is in an area where grass is not tall.
- Do not leave vehicle idling once stopped.
- When possible, try to drive through areas where grass is not tall or grass has been beaten down.
- Ensure that a fire extinguisher is available for each vehicle.
- Keep fire extinguisher readily available in passenger area of vehicle while driving.
- Keep fire extinguisher outside of vehicle upon stopping.
- Address fire hazards and controls in daily safety briefings as appropriate.

2.2.15 Severe Weather

- Work may proceed in light rain- wear rain gear.
- Exposure to slips, trips and falls is increased during rainy and snowing conditions.
- Take cover in field vehicle during adverse weather conditions (High winds, heavy rain, lightning).
- Work shall cease and cover sought in the event of lightning or tornado warnings.

- Identify "Take Shelter" areas before starting project.
- Work may proceed in light rain- wear rain gear.
- Notify the Project Manager and Client Representative after shelter has been sought.

2.2.16 Working On or Above Water

(Reference CH2M HILL SOP HSE-404, *In-water, wetland and coastal work*)

- Safe means of boarding or leaving the boat or platform must be provided to prevent slipping and falling.
- All persons participating in boating operations will be directed by the SSC.
- All personnel shall wear their Personnel Floatation Devices (PFD) at all times while they are on the water.
- The boating team will include at least one person qualified in First Aid.
- Team Leader has final authority on operations with regards to weather and water conditions
- All operations involving boating will be directed by qualified and experienced boater.
- The Safe Boating Checklist found in Attachment 5 of this safety plan will be completed at the frequency specified in Section 2 of this plan.
- Boat/barge must be equipped with adequate railing.
- Boat/barge must be operated according to U.S. Coast Guard regulations (speed, lightning, right-of-way, etc.).
- Staff should be instructed on safe use and operation of boat prior to use.
- Work requiring the use of a boat will not take place at night or during inclement weather.
- Shut off engine before refueling.
- Do not smoke while refueling.
- Fall protection should be provided to prevent personnel from falling into water. Where fall protection systems are not provided and the danger of drowning exists, U.S. Coast Guard-approved personal flotation devices (PFDs), or life jacket, shall be worn.
- Inspect PFDs prior to use. Do not use defective PFDs.
- A life-saving skiff must be provided for emergency rescue.
- A minimum of one ring buoy with 90 feet of 3/8-inch solid-braid polypropylene (or equal) rope must be provided for emergency rescue.
- Use sampling and other equipment according to the manufacturers' instructions.

2.3 Biological Hazards and Controls

2.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Seek medical attention immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

Things to Do	Things NOT to Do
Move victim, and everybody else, away from snakes;	Do not cut and suck the wound, either manually or orally;
Identify the snake - kill it <u>ONLY</u> if necessary;	Do not apply a tight, narrow band tourniquet - these cause amputations!;

Lie the victim down with the bite area at or just slightly below the heart level;	Do not apply ice or heat packs, and do not use a stun gun on the bite area;
Calm the victim by explaining the facts about snakebites;	Do not give the victim any food or drink, and this applies especially to alcohol!;
Immobilize the bite area with a splint and sling, if possible;	Do not allow the victim to become alarmed, excited or agitated, as this will only increase blood flow and the chances of getting poison to the heart;
Remove constricting jewelry or clothing unless the victim resists;	Do not allow victim to exercise vigorously, including running;
Get professional medical help as quickly as possible.	If you must kill the snake, then do NOT touch its head for at least one hour. If you must kill a snake for identification purposes, then completely remove its head and bury it. Snake heads have been documented as capable of biting and injecting poison an hour or more after decapitation;
	Do not waste valuable time on unimportant acts like trying to find a snake to identify or kill it. Hemotoxic poison will start to enter the blood stream within 30 minutes, and neurotoxic poison works even faster.

Each year, about 9,000 people are bitten by poisonous snakes in the U.S. Only about 15-25% actually receive venom, and U.S. deaths from snakebites only total about 12-15 people annually. In 2002, there were only 9 snakebite deaths in the US. Most snakebite deaths occur in small, young children whose lack of body mass and immune system development make them more susceptible to snake venom. However, a far larger number of people suffer medical complications ranging from mild to serious problems from improper treatment than the number who die. Therefore, knowing what to do to avoid snakebites and how to properly treat them if they occur is critical to preventing permanent injury or death.

Following the above protocols will greatly reduce the chances of serious complications from snakebites. Bear in mind that few people die from poisonous snakebites and the vast majority of snakebite victims are not even venomized. Snakes generally reserve their venom for prey they intend to eat. If you encounter a snake that can eat you, then you have a much bigger problem than poisoning! No such snakes exist, especially in the U.S. Above all else, **DO NOT PANIC!** Snakebites are more a nuisance than a serious medical problem in most cases, and in the other cases panic will merely result in a loss of efficiency in getting a victim to professional treatment, which may result in serious injury or death.

2.3.2 Poison Ivy and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Become familiar with the identity of these plants. Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention. Additional information and photographs of each are provided in Attachment 12.

2.3.3 Ticks

Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size. Wear tightly woven light-colored clothing with long

sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permethrin and spray skin with only DEET; and check yourself frequently for ticks.

If bitten by a tick, grasp it at the point of attachment and carefully remove it. After removing the tick, wash your hands and disinfect and press the bite areas. Save the removed tick. Report the bite to human resources. Look for symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both cases, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, seek medical attention.

2.3.4 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform the SSC and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

2.3.5 Bloodborne Pathogens

(Reference CH2M HILL SOP HS-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material. Exposure controls and personal protective equipment (PPE) are required as specified in CH2M HILL SOP HS-36, *Bloodborne Pathogens*. Hepatitis B vaccination must be offered before the person participates in a task where exposure is a possibility.

2.3.6 Mosquito Bites

Due to the recent detection of the West Nile Virus in the Southeastern United States it is recommended that **preventative measures** be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquitoes are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis. The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent.

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35% DEET (N,N-diethyl-meta-toluamide). DEET in high concentrations (greater than 35%) provides no additional protection.
- Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.

Note: Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.

The West Nile Virus incubation period is from 3-15 days.

If you have any questions or to report any suspicious symptoms, contact the project Health and Safety Manager (HSM).

2.3.7 Spiders

Black Widow

Description

The female black widow spider is almost twice the size of its male counterpart. Although both are considered venomous, only the female spider is able to bite and envenomate humans. During the summer months, the female black widow spider is the most venomous. The spider undergoes multiple moltings throughout the year and often changes color. The female is most often shiny black in color and has a rounded abdomen with a red distinctive hourglass on its ventral surface. Occasionally, two red spots may be seen instead of the hourglass configuration.

Symptoms

When bitten by a black widow spider, the symptoms usually begin with a pinprick sensation, followed by the appearance of mold swelling and redness around the bite wound. It is not unusual for the patient to be unaware of the bite until a local reaction has occurred. Close evaluation of the site may reveal two fang marks. The first hour after the bite, pain often increases around the area of the bite and spreads to the entire body. Upper extremity bites usually lead to spasm of the upper trunk muscles; bites of the lower extremity often lead to abdominal spasms.

Other common symptoms include an abnormal sensation in the extremities (i.e., prickling or burning), deep tendon reflexes, headache, anxiety, nausea, vomiting, tremor, restlessness, and seizures may also be seen. Symptoms usually resolve within 24-48 hours

General treatment includes local wound care, a tetanus shot, and pain medication is needed. Airway, breathing, and circulation should be monitored closely.

Prevention

Wear gloves, heavy garments that are fully buttoned, and protective footwear when working in areas where spiders commonly inhabit (i.e., dark and protected spaces such as wells, rock and wood piles, pipes, gloves, boots, etc.)

Brown Recluse

Description

The brown recluse spider is approximately 1 cm in body length, with a leg span of up to 2.5 cm. The color of these spiders is usually tan to brown.

Symptoms

Envenomation is initially painless for most victims. Within the first few hours, pain and redness occur at the site of the bite. The bite mark may resemble a bull's-eye and is most often 1-5 cm in diameter. Over the next few days, the bite area will ulcerate and spread in diameter and into the fatty tissue below. In

one week after the bite a large area of skin and tissue can be involved. Surgical intervention is usually required to remove the bite area.

Systemic reactions, while uncommon, can occur in some individuals. These symptoms usually occur within 2 days of the bite and can include fever, chills, rash, nausea, vomiting, and possible renal failure.

General treatment includes local wound care, tetanus inoculation, immobilization, elevation, observation, and surgical removal of the wound.

Prevention

Wear gloves, heavy garments that are fully buttoned, and protective footwear when working in areas where spiders commonly inhabit (i.e., dark and protected spaces such as wells, rock and wood piles, pipes, gloves, boots, etc.)

Additional information regarding spiders can be found in Attachment 11.

2.4 Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum ^a Concentration (ppm)	Exposure Limit ^b	IDLH ^c	Symptoms and Effects of Exposure	PIP ^d (eV)
1,1 Dichloroethene	GW: 5.1 ug/l	200 ppm	1,000 ppm	Irritation to eyes; CNS depression	10.0
2,4 Dimethylphenol	GW: 7,400 ug/l				
Arsenic	GW: 62,100 ug/l SB: 3370 mg/kg	0.01 mg/m ³	5 mg/m ³ Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Benzene	GW: 11,000 ug/l SB: 51 mg/kg	0.5 ppm STEL 5 ppm	500 ppm Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
Benzo(a)anthracene	GW: 46 ug/l	0.2 mg/m ³	80 mg/m ³	Dust- confusion, nausea, eye irritant, headache, stomach pain	N/A
Benzo(a)pyrene	GW: 32 ug/l	0.2 mg/m ³	80 mg/m ³	Dust- confusion, nausea, eye irritant, headache, stomach pain	N/A
Benzo(b)fluoranthene	GW: 39 ug/l	0.2 mg/m ³	80 mg/m ³	Dust- confusion, nausea, eye irritant, headache, stomach pain	N/A
Benzo(k)fluoranthene	GW: 13 ug/l	0.2 mg/m ³	80 mg/m ³	Dust- confusion, nausea, eye irritant, headache, stomach pain	N/A
Chrysene	GW: 47 ug/l	0.2 mg/m ³	80 mg/m ³	Dust- confusion, nausea, eye irritant, headache, stomach pain	N/A
Chromium (as Cr(II) & Cr(III))	GW: 33.9 ug/l SB: 676 mg/kg	0.5 mg/m ³	25 mg/m ³	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	NA
Dibenz(a,h)anthracene	GW: 2 ug/l	0.2 mg/m ³	80 Ca	Dermatitis and bronchitis	N/A
Ethylbenzene	GW: 1,200 ug/l SB: 290 mg/kg	100 ppm	800 ppm	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Indeno(1,2,3-cd)pyrene	GW: 12 ug/l	0.2 mg/m ³	80 Ca	Dermatitis and bronchitis	N/A
Lead	GW: 58.5 ug/l SB: 10,800 mg/kg	0.05 mg/m ³	100 mg/m ³	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Naphthalene	GW: 16,000 ug/l SB: 5,300 mg/kg	10 ppm	250 ppm	Eye irritation, headache, confusion, excitement, nausea, vomiting, abdominal pain, bladder irritation, profuse sweating, dermatitis, corneal damage, optical neuritis	8.12

Contaminant	Location and Maximum ^a Concentration (ppm)	Exposure Limit ^b	IDLH ^c	Symptoms and Effects of Exposure	PIP ^d (eV)
PCBs (Limits as Aroclor 1254)	SB: 3.2 mg/kg	0.5 mg/m ³	5 mg/m ³ Ca	Eye and skin irritation, acne-form dermatitis, liver damage, reproductive effects	UK
Phenol	GW: 3,100 ug/l	5 ppm	250 ppm	Corrosive to skin; eye irritant, muscleaches, dark urine	8.50
PNAs (Limits as Coal Tar Pitch)	GW: UK SB: UK	0.2 mg/m ³	80 mg/m ³ Ca	Eye, skin and respiratory tract irritation. Prolonged contact with skin may cause dermatitis and hyperpigmentation of skin.	UK
Styrene	GW: 460 ug/l	20 ppm	700 ppm	Irritation to eyes & nose, dizziness, weakness	8.47
Tetrachloroethylene	GW: 7.5 ug/l	25 ppm	150 ppm	Irritation to eyes, nose, throat; flushed face/neck, dizziness	9.32
Toluene	GW: 4,400 ug/l SS: 310 mg/kg	50 ppm	500 ppm	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, dermatitis, liver and kidney damage	8.82
Trichloroethylene	GW: 380 ug/l	50 ppm	1,000 ppm	Vertigo, visual disturbances, headaches, drowsiness	9.45
Xylenes	GW: 3,400 ug/l SB: 200 mg/kg	100 ppm	900 ppm	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; nausea; vomiting; abdominal pain; dermatitis	8.56
Footnotes: ^a Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), SS (Surface Soil), SL (Sludge), SW (Surface Water). ^b OSHA PEL or ACGIH TLV lowest value listed. ^c IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); ND = Not determined; CA = Potential occupational carcinogen. ^d PIP = photoionization potential; NA = Not applicable; UK = Unknown.					

2.5 Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Personal Protective Equipment (PPE) Section of this plan.

Inhalation: Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Personal Protective Equipment (PPE) and Air Monitoring/Sampling Sections of this plan, respectively.

Other: Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3 Project Organization and Responsibilities

3.1 Client

Contact Name: Tim Metcalf
Phone: 973-455-4107
Facility Contact Name: N/A
Phone:

3.2 Owner

Contact Name: N/A
Phone:
Onsite Contact Name:
Phone:

3.2 CH2M HILL Employee Medical Surveillance, Training, & Drug Testing

(Reference CH2M HILL SOPs HSE-113, *Medical Surveillance*, HSE-110, *Training*, HSE-105, *Drug-Free Workplace*)

Employees assigned to this project will have the following minimum training.

- 40-hour hazardous waste operations training
- 3-day on-the-job experience
- 8-hour annual hazardous waste refresher training.
- Employees who are in an on-site supervisor role will complete 8 hours of hazardous waste supervisor training
- Drug-Free Workplace training (when drug testing is required)
(http://www3.int.ch2m.com/intrnl/voffice/corp/health/Training_Basic_Modules/Drug1.html)
- Honeywell Program orientation
- Site-specific training/orientation

Employees designated as Safety Coordinator (SC) have completed a 12-hour safety coordinator course. The safety coordinator training course meets the requirements of 29 CFR 1910.120 for on-site supervisor training. An SC must be present during all tasks performed in exclusion or decontamination zones. The SC and additional designated employees, as necessary, will be certified in first aid and cardiopulmonary resuscitation (FA-CPR) by the American Red Cross, or equivalent. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training. Additional training requirements are addressed in the specific hazard sections of this plan.

Employees who perform work activities in the decontamination or exclusion zone shall be enrolled in and have a current medical clearance as required by the medical surveillance program for hazardous waste workers. Pregnant employees shall consult with the Corporate Consulting Physician prior to performing site activities and obtain a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Drug testing for the tasks identified in Section 1 is not required for CH2M HILL employees. If site conditions change and tasks are added contact the HSM to determine if drug testing will be required.

If site conditions and tasks change staff who conduct fieldwork for this project may be required to pass an initial 5-panel drug screen and an alcohol screen within two weeks prior to starting field activities. They will be required to enroll in a random testing program for the duration of their work on Honeywell, and will be subject to post-incident and "for cause" testing.

Based on specific work activities/tasks, the drilling and boat operator contractor-subcontractor personnel will have to pass an initial 5-panel drug screen and an alcohol screen within two weeks prior to starting field activities. They will be required to enroll in a random testing program for the duration of their work on Honeywell, and will be subject to post-incident and "for cause" testing.

Employee Name	Office	Responsibility	SC/FA-CPR
Jennifer Simms	PHL	SC-FTL	Level C SC/FA-CPR
Austin Harclerode	NJO	FTM	Level C SC/FA-CPR
Drue Roberts	DAY	FTM	Level C SC/FA-CPR

3.3 CH2M HILL Staff Responsibilities

3.3.1 CH2M HILL Project Manager

The CH2M HILL project manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HSE management process. The PM has overall management responsibility for the tasks listed below. The PM may delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this HS&E Plan:

- Incorporate standard terms and conditions, and contract-specific HSE roles and responsibilities in the contract with the client.

- Budget for the appropriate level of HSE oversight during field activities. Contact the HSM for budget requirements and guidelines.
- Manage the site and interface with third parties in a manner consistent with our contract and subcontract agreements and the applicable standard of reasonable care.
- Ensure that the overall, project-specific HS&E goals are fully and continuously implemented.
- Ensure that CH2M HILL's safety coordinator is completing all duties outlined in this HS&E Plan.
- Promoting a safety culture with onsite CH2M HILL personnel and setting the example for safe behavior.

The PM has the following additional responsibilities when subcontractors are hired:

- Incorporate standard terms and conditions, and contract-specific HSE roles and responsibilities in subcontract agreements (including flow-down requirements to lower-tier subcontractors).
- Select safe and competent subcontractors by implementing the CH2M HILL Subcontractor Management Program. This program includes the review of subcontractor pre-qualification questionnaires, training and medical monitoring records, and site-specific safety procedures prior to the start of subcontractor's field operations.
- Ensure that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award.
- Maintain copies of subcontracts and subcontractor certificates of insurance, bond, contractors license, training and medical monitoring records, and project-specific HSE procedures in the project file accessible to site personnel.
- Provide adequate oversight of subcontractor HSE practices per the HS&E Plan.

3.3.2 CH2M HILL Project Health and Safety Manager

The CH2M HILL Project Health and Safety manager (HSM) is responsible to:

- Support the SC's oversight of HSE practices and interfaces with onsite third parties per the HS&E Plan.
- Conduct audits, as necessary, to assess site conditions and review HSE program implementation.
- Assist the PM with HSE budget guidelines.
- Assist with program implementation as needed.

The HSM has the following additional responsibilities when subcontractors are hired:

- Ensure that subcontractor pre-qualification questionnaires are reviewed and assist as applicable in the acceptance or rejection.
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor's field operations.
- Support the SC's oversight of subcontractor's (and lower-tier subcontractor's) HS&E practices per the HS&E Plan.

3.3.3 Safety Coordinator

The Safety Coordinator (SC) shall be onsite for the duration of onsite work and is responsible for verifying that the project is conducted in a safe manner including the following obligations:

- Verify that this HS&E Plan is current and amended when project activities or conditions change.
- Verify that CH2M HILL site personnel and subcontractors read this HS&E Plan and sign the CH2M HILL Employee Sign-Off Form included in Attachment 1.
- Verify compliance with the requirements of this HS&E Plan, applicable contractor health and safety plan(s) and any federal, state, and local regulations.
- Review and understand contractual obligations regarding HSE roles and responsibilities.
- Manage the site and interfacing with third parties in a manner consistent with our contract/subcontract agreements and the applicable standard of reasonable care.
- Ensure that programs are effectively functioning to prevent and control hazards on the project.
- Verify that all CH2M HILL employees working in the field have the appropriate level of HSE training, medical surveillance, and drug and alcohol testing for their job duties including required specialty training (e.g., fall protection, confined space entry) identified in the Hazard Controls and Safe Work Practices Section of this HS&E Plan.
- Conduct an HSE orientation for all CH2M HILL team members prior to entering the project work areas and deliver field HSE training as needed based on project-specific hazards and activities.
- Maintain active and visible involvement using open communication with employees regarding safety issues on the project.
- Verify that safety meetings are conducted and document in the project file as needed throughout the course of the project (e.g., as tasks or hazards change).
- Attend Contractor safety meetings and ask questions about access to work areas, safety hazards, precautions and other general safety issues.
- Post required information onsite. The OSHA job-site poster is required at sites where project field offices, trailers, or equipment-storage boxes are established. Contact the HSM for posters.
- Maintain HSE records and documentation.
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the Hazard Communication section of this HS&E Plan.
- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in the Emergency Preparedness section of this HS&E Plan.
- Verify that project HSE forms, permits and self-assessment checklists are being used as outlined in this plan.
- Ensure that the Drug Testing Hospital Kit is available onsite in the event of a serious injury involving hospital, ambulance, or paramedic care. The hospital kit must accompany the injured employee to the hospital so they will get drug tested. For additional information on the Drug Testing Hospital Kits, refer to Attachment 10.
- Verify appropriate personal protective equipment (PPE) use, availability, and training.

- Inform the HSM of any project incident, ensure that an Incident Report Form (IRF) is completed and conduct incident investigations as outlined in the Incident Reporting and Investigation section of this HS&E Plan.
- Facilitate Occupational Safety and Health Administration (OSHA) or other government agency inspections including accompanying inspector and providing all necessary documentation and follow-up.
- Report all incidents to your HS&E Manager and/or the Honeywell HSPM immediately. Depending on the type and severity of incident, we may have to report it to Honeywell within hours of occurrence. The Honeywell HSPM will determine what needs to be reported, the timing of the reporting, and coordinate client notification so local and Corporate Honeywell personnel are appropriately notified.

The SC has the following additional responsibilities when subcontractors are hired:

- Verify that project files available to site personnel include copies of executed contracts and certificates of insurance; bond; contractors license; training, medical monitoring, and drug and alcohol testing records; and project-specific HSE procedures prior to start of subcontractor's field operations.
- Verify that ongoing training, medical monitoring, and drug and alcohol testing requirements are being met (e.g., 8-hour refresher, random drug testing programs, etc).
- Perform oversight and/or assessments of subcontractor HS&E practices per this HES plan and verify that project activity self-assessment checklists, found in Attachment 3.

3.3.4 CH2M HILL Employees

All personnel are assigned responsibility for safe and healthy operations. This concept is the foundation for involving all employees in identifying hazards and providing solutions. For any operation, individuals have full authority to stop work and initiate immediate corrective action or control. In addition, each worker has a right and responsibility to report unsafe conditions/practices. This right represents a significant facet of worker empowerment and program ownership. Through shared values and a belief that all accidents are preventable, our employees accept personal responsibility for working safely. Each employee is responsible for the following:

- Perform work in a safe manner without injury, illness or property damage.
- Perform work in accordance with company policies, and report near misses, injuries, illnesses, and unsafe conditions.
- Report all incidents, include near misses, immediately to supervisor, and file proper forms with a human resources representative. Contact your HS&E Manager and the Honeywell HSPM to ensure client reporting procedures are met. It is important to do incident notification immediately because, depending on the type of incident, we may be required to report to Honeywell within hours of the event.
- Report all hazardous conditions and/or hazardous activities immediately to a supervisor for corrective action.
- Intervene when an unsafe behavior and/or condition is observed.
- Complete an HSE orientation prior to being authorized to enter the project work areas.

- Inspect assigned PPE to ensure the absence of defects and proper function

3.4 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, *Contracts, Subcontracts, and HSE Management Practices*)

Subcontractor: Ocean Surveys, Inc.

Subcontractor Safety Representative: Mark L. Kosakowski

Subcontractor's onsite activities: Geoprobe direct push investigation work in river sediment, Vibracore sampling in river sediment, cutting and transport of sediment cores to shore after collection, decontamination of sampling and drilling equipment, bathymetric survey of river bottom, utility survey (magnetometer and side scan sonar) of river bottom.

The subcontractors listed above are covered by this HS&E Plan and must be provided a copy of this document. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with all established health and safety plan(s) for this project. The CH2M HILL SC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established HS&E Plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL team members should continuously endeavor to observe subcontractors' safety performance. This endeavor should be reasonable, and include observation of hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. In addition to this level of observation, the SC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's task specific safety procedures and applicable self-assessment checklists. Self-assessment checklists, provided in Attachment 3.

HSE related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the CH2M HILL HS&E Plan Employee Sign-Off Form, included in Attachment 1.
- Request subcontractor(s) to brief project team on the hazards and precautions related to their work.
- When apparent, non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected personnel, notify subcontractor safety representative, stop affected work until adequate corrective measures are implemented, and notify the Project Manager, HSM, and SC as appropriate.
- Document all verbal HSE related communications in project field logbook, daily reports, or other records.

Subcontractors are responsible to:

- Comply with all local, state, and federal HSE standards; and project/owner HSE requirements.
- Provide a qualified subcontractor safety representative (SSR) to oversee the subcontractor activities and conduct safety inspections for their work.
- Conduct site-specific orientations for all subcontractor employees.

- Actively participate in the project HSE program and attend all required safety meetings.
- Meet training, medical monitoring, and drug and alcohol testing requirements for their staff.
- Intervene when they observe unsafe behaviors and/or conditions.
- Maintain equipment and supplies necessary to complete activities in a safe manner.
- Notify the CH2M HILL SC of any injury or incident, including near-misses, immediately and submit reports to CH2M HILL within 24 hours. Additionally, all incidents must be reported to the HS&E Manager and Honeywell HSPM immediately so we can meet Honeywell's incident reporting requirements.

3.5 3rd Parties

(Reference CH2M HILL SOP HSE-215, *Contracts, Subcontracts, and HSE Management Practices*)

Not anticipated during this phase of field work.

3rd Party's Name:

Safety Representative:

Onsite Activities:

This HS&E Plan does not cover parties who do not have a contractual relationship with CH2M HILL. CH2M HILL is not responsible for the health and safety or means and methods of the contractor's work, and we must never assume such responsibility through our actions (e.g., advising on H&S issues). In addition to this plan, CH2M HILL staff should review 3rd parties' safety plans so that we remain aware of appropriate precautions that apply to us. Except in unusual situations when conducted by the HSM, CH2M HILL must never comment on or approve a 3rd party's safety procedures. Self-assessment checklists, provided in Attachment 3, are to be used by the SC to review the 3rd party's performance ONLY as it pertains to evaluating CH2M HILL employee and subcontractor exposure and safety.

HSE related communications with 3rd parties should be conducted as follows:

- Request the 3rd party to brief CH2M HILL employees and subcontractors on the precautions related to the contractor's work.
- When an apparent 3rd party's non-compliance/unsafe condition or practice poses a risk to CH2M HILL employees or subcontractors:
 - Notify the 3rd party's safety representative
 - Request that the 3rd party determine and implement corrective actions
 - If needed, stop affected CH2M HILL work until the 3rd party corrects the condition or practice. Notify the client, Project Manager, and HSM as appropriate.
- If apparent 3rd party's non-compliance/unsafe conditions or practices are observed, inform the 3rd party's safety representative. CH2M HILL's obligation is limited strictly to informing the 3rd party of the observation – the 3rd party is solely responsible for determining and implementing necessary controls and corrective actions.
- If an apparent imminent danger is observed, immediately warn the 3rd party's employee(s) in danger and notify the 3rd party's safety representative. CH2M HILL's obligation is limited strictly to immediately warning the affected individual(s) and informing the 3rd party of our observation – the 3rd party is solely responsible for determining and implementing necessary controls and corrective actions.
- Document all verbal HSE related communications in project field logbook, daily reports, or other records.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HSE-117, *Personal Protective Equipment*, HSE-121, *Respiratory Protection*)

The PPE hazard assessment performed by the HSM requires the following PPE for use during site activities. The PPE required by the table will be evaluated periodically, by the SC, to ensure the adequacy based on air monitoring results or changes to expected site conditions. The SC shall coordinate all changes with the HSM.

4.1 PPE Specifications ^a

Task	Level	Body	Head	Respirator ^b
General site entry and mobilization Oversight from land	D	Work clothes; steel-toe, leather work boots; Leather work gloves as necessary.	Hardhat ^c Safety glasses Ear protection ^d	None required
Sediment sampling using Vibracore drilling and TARGost work activities on boat/barge; surface water sampling from boat/barge; Oversight from boat/barge	Modified D	Work clothes; steel toe leather work boots, leather work gloves as necessary When handling potentially contaminated materials from sampling cores: Tyvek suits; Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers; Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Safety glasses Ear protection ^d	None required
All tasks requiring upgrade	C	Coveralls: Polycoated Tyvek® Boots: Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers Gloves: Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat ^c Splash shield ^c Ear protection ^d Spectacle inserts	APR, full face, with Organic Vapor/P100 combination cartridges.

^a Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.

^b No facial hair that would interfere with respirator fit is permitted.

^c Hardhat and splash-shield areas are to be determined by the SC.

^d Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

* Cartridge change-out schedule will be established by the HSM and at a minimum shall be at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)– then at least every 4 hours. If encountered conditions are different than those anticipated in this HS&E Plan, contact the HSM.

4.2 Reasons for Upgrading or Downgrading Level of Protection

Upgrade^f

- Request from individual performing tasks.
- Change in work tasks that will increase contact or potential contact with hazardous materials.
- Occurrence or likely occurrence of gas or vapor emission.
- Known or suspected presence of dermal hazards.
- Instrument action levels (Section 5) exceeded.

Downgrade

- New information indicating that situation is less hazardous than originally thought.
- Change in site conditions that decreases the hazard.
- Change in work task that will reduce contact with hazardous materials.

^f Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HSE-207, *Exposure Assessment for Airborne Chemical Hazards*)

Air monitoring and sampling must be performed to verify that our employees are not be exposed to harmful levels of airborne contaminants and that airborne contaminants are not migrating into public areas.

5.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels ^a		Frequency ^b	Calibration
Photoionization Detector: OVM with 10.6eV lamp or equivalent	Work activities from boat/barge	0 - 1 ppm	Level D	Initially and periodically during task	Daily
		1 -5 ppm, begin benzene monitoring	Level C		
		5 - 25 ppm	Halt operations and contact HSM		
		> 25 ppm			
Colormetric Tube: Drager or equivalent benzene specific (0.5 to 10 ppm range) with pre-tube, or equivalent	Work activities from boat/barge	< 1 ppm	Level D	Initially and periodically when PID >1 ppm	Not applicable
		1 -5 ppm	Level C		
		> 5 ppm	Halt operations and contact HSM		
Noise-Level Monitor ^d :	Work activities from boat/barge			Initially and periodically during task	NA
Auditory		Conversations can be held at distances of 3 feet without shouting	→ No action required		
		Conversations cannot be held at a distances of 3 feet without shouting	→ Hearing protection required		

^a Action levels apply to sustained breathing-zone measurements above background.

^b The exact frequency of monitoring depends on field conditions and is to be determined by the SC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3," "at surface/SB-2," etc.).

^c If the measured percent of O₂ is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O₂ action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O₂ action levels are required for confined-space entry (refer to Section 2).

^d Refer to SOP HSE-604 for instructions and documentation on radiation monitoring and screening.

^e Noise monitoring and audiometric testing also required.

5.2 Calibration

Instruments will be function tested in accordance with the respective manufacturer's instructions for proper instrument use and maintenance. The instrument vendor or the CH2M HILL warehouse staff will ensure equipment has been calibrated in accordance with manufacturer's specifications.

All direct reading instruments will be function tested daily by the SC using span gas, prior to performing work activities and after the completion of the daily activities.

5.3 Air Sampling

Personal air sampling is not anticipated during this field project. If site conditions change the HSM may determine that personal air sampling is warranted.

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, beryllium, hexavalent chromium, benzene, methylene chloride, vinyl chloride and certain volatile organic compounds. Air sampling methods will be NIOSH or OSHA certified and samples analyzed by a laboratory that is accredited by the American Industrial Hygiene Association (AIHA) for the compound specific method.

The HSM will develop and specify a sampling approach that includes the number and frequency of sampling events. This approach will be included in this section. The HSM shall interpret all air sampling results and modify the requirements of this HS&E Plan, based on the interpretation. Written notification of air sampling results will be provided to the CH2M HILL site employees and maintained in their HSE records.

6 Decontamination

(Reference CH2M HILL SOP HSE-506, *Decontamination*)

The SC must establish the specific decontamination procedures for the specific site tasks. Possible decontamination procedures are provided in Section 6.1. The SC must monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

6.1 Decontamination Specifications

Personnel	Sample Equipment	Heavy Equipment
<ul style="list-style-type: none">• Boot wash/rinse• Glove wash/rinse• Outer-glove removal• Body-suit removal• Inner-glove removal• Respirator removal• Hand wash/rinse• Face wash/rinse• Shower ASAP• Dispose of PPE in municipal trash, or contain for disposal• Dispose of personnel rinse water to facility or sanitary sewer, or contain for offsite disposal	<ul style="list-style-type: none">• Wash/rinse equipment• Solvent-rinse equipment• Contain solvent waste for offsite disposal	<ul style="list-style-type: none">• Power wash• Steam clean• Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

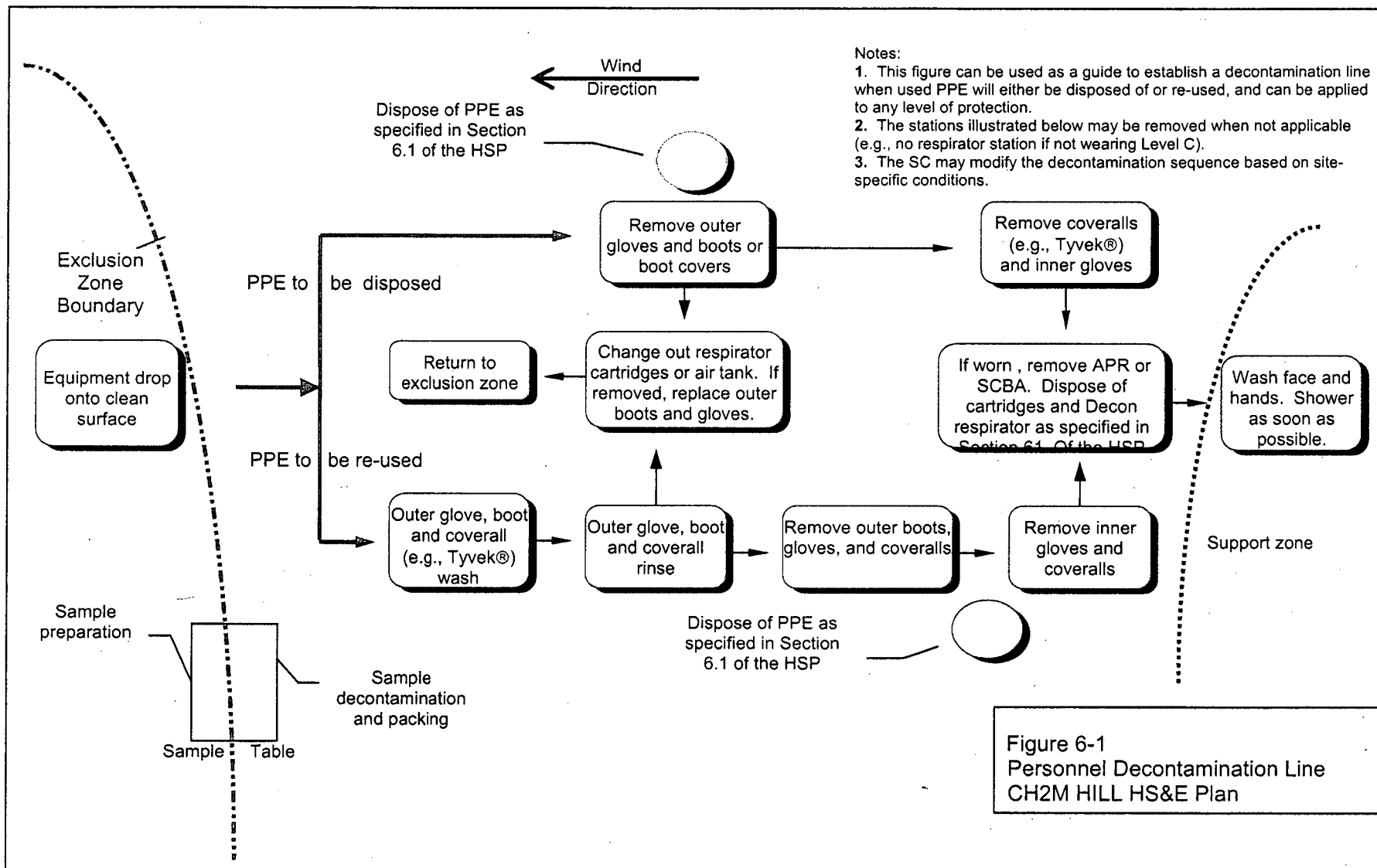
6.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking.

Figure 6-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SC to accommodate task-specific requirements.

6.3 Collection and Disposal of Decontamination Wastes

Contaminated materials, PPE and fluids shall be managed according to procedures in the Waste Management Plan in the Work Plan. If not available contact the Environmental Compliance Contact for additional details/procedures.



7.0 Spill Containment and Notification

SPCC-Regulated Project or Facility – If the client facility is subject to a Spill Prevention, Control and Countermeasures (SPCC) Plan, a copy must be obtained and all spill prevention and response must conform to client SPCC requirements. If the client does not have an SPCC Plan and the project requires storage of more than 1,320 gallons of petroleum in 55-gallon containers or greater, a project-specific SPCC plan will be prepared.

Non-SPCC Project or Facility – Projects not subject to SPCC requirements, or storing other hazardous materials shall comply with this section. All onsite personnel shall be trained to follow the procedures described in this section.

- **Equipment** – Obtain client prior approval for use of client-owned spill containment equipment. If client equipment is not available, the table below provides typical spill equipment that shall be available in the project's support zone. Consult the regional ECC and MSDS for more information.

Minimum Spill Kit Equipment List

Spill Kit

Absorbent material (kitty litter or vermiculite)
Neutralizers (for chemical spills)

- Sodium Carbonate (acid spills)
- Citric Acid (base spills)

Absorbent socks and pads
Safety Goggles
Protective Gloves
Tyvek Suit
Waste Containers and Labels

- **Emergency Spill Event** – The release of an unknown hazardous material is considered an emergency spill event. Implement the following procedures during an emergency spill event:
 1. Evacuate the area and go upwind
 2. Warn others and direct them upwind
 3. Immediately contact the onsite Safety Coordinator who will contact the HSM for direction
- **Non-Emergency Spill Event** – A non-emergency spill event includes incidental releases that do not pose a significant safety or health hazard where chemical hazards are known and CH2M HILL personnel can safely implement the following procedures as a first responder:
 1. Stop the source of the spill
 2. Contain the spill material. If there is a chance the spill will reach nearby drains or waterways, block them off to keep the spill away
 3. Contact the onsite Safety Coordinator
- **Cleanup** – Clean up the spilled material wearing the proper PPE identified in the HS&E Plan equipment table if the spilled material is less than 5 gallons and hazards are known. Spills larger than 5 gallons must be cleaned up by a qualified subcontractor since CH2M HILL personnel are not trained to implement OSHA spill response requirements. Dispose of spill debris according to the Waste Management Plan or as directed by the ECC.

- **Notification and Reporting** - All spills are considered an "incident" and shall be reported internally according to procedures in HSE-111 (Incident Reporting and Investigation SOP). Since many spills may require agency reporting within 24 hours, it is very important that internal notification occur immediately. The following summarizes required actions:
 1. *Immediately* notify the onsite Safety Coordinator
 2. SC notifies the HSM
 3. HSM notifies the Project Manager, who notifies the client
 4. HSM notifies the Legal Department of a serious incident
 5. HSM, ECC, and client shall determine if the incident is reportable to an agency

8.0 Site-Control Procedures

(Reference CH2M HILL SOP HSE-510, *Site Control*)

- The SC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety include general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SC will record attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location if CH2M HILL occupies an onsite field trailer or office. Postings must be in accordance with CH2M HILL SOP HSE-116, *OSHA Postings*.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
 - Line-of-sight and hand signals
 - Air horn
 - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SC in appropriate level of protection.
- The SC is to conduct periodic inspections of work practices to determine the effectiveness of this plan - refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

9.0 Hazwoper Compliance Plan

(Reference CH2M HILL SOP HSE-220, *Site-Specific Written Safety Plans*)

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 1.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff are working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The HSM must approve the interpretation of these data. Refer to subsections 2.5 and 5.3 for contaminant data and air sampling requirements, respectively.
- When non-Hazwoper-trained personnel are at risk of exposure, the SC must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
 - Nature of the existing contamination and its locations
 - Limitations of their access
 - Emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Procedures for remediation treatment system start-ups are as follows: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hour of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

10 Incident Reporting and Investigation

(Reference CH2M HILL SOP HSE-111, *Incident Reporting and Investigation*)

10.1 Definitions

10.1.1 Incident

An incident is an undesired event that results or could have resulted in an injury, illness, damage to assets or environment harm. The following events shall be considered incidents:

- Injury or illness to a CH2M HILL employee or CH2M HILL subcontractor employee
- Injury or illness to a third party that was caused by a CH2M HILL activity
- Hazardous substance exposure
- Damage to property or equipment
- Motor vehicle accident
- Fire or explosion
- Spill or release
- Environmental issue permit violation
- A "near-miss"

10.1.2 Near-Miss

A near-miss occurs when an intervening factor prevented an injury, damage to property, or environmental harm from occurring. Examples of near-miss situations include: a hard hat or other personal protective equipment (PPE) prevented an injury; secondary containment or emergency shutoff prevented a spill; or an alert co-worker prevented an accident.

10.1.3 Serious Incidents

The HSM and Legal and Insurance Department (LID) shall determine if an event should be considered as a serious incident after reviewing the initial incident facts. The general criteria for serious incidents include:

- Intervention by external emergency response organizations
- Hospitalization
- Spills and releases of hazardous substances exceeding the reportable quantity (RQ)
- Potential violations of law or regulation
- Estimated property damage in excess of \$10,000

10.2 Incident Notification and Communication

All CH2M HILL and subcontractors' employees shall immediately report any incident in which they are involved to their direct supervisor, and the supervisor shall inform the CH2M HILL Site Safety Coordinator. The SC shall then contact the PM, HS&E Manager, and the Honeywell HSPM immediately. Immediate reporting is critical because there are certain types of incidents that must be reported to Honeywell within hours of occurrence. The Honeywell HSPM will help the team determine what needs to be reported to Honeywell, how quickly it needs to be reported to Honeywell, and who at Honeywell (local, corporate, etc) needs to be notified, etc.

Incident communications regarding serious incidents (regardless of the party involved) shall be considered sensitive in nature and must be controlled in a confidential manner. Internal communications regarding a serious incident may be conducted with affected project, regional, and Business Group staff but must be kept to a minimum. Communication should be oral whenever possible. If e-mail communications are necessary they shall be sent as confidential emails following the procedure provided in section 6.2.2 of the *Incident Reporting and Investigation SOP* (HSE-111). A LID representative shall direct all internal and external communications, including internal incident reporting, agency reporting, client notification, and incident investigations.

10.3 Incident Reporting

The PM or the HSPM will be responsible to ensure that the incident is entered into Honeywell's event tracking system and a CH2M HILL Incident Report Form (IRF) is completed within 24 hours of any incident. The HSPM can assist with complying with entering information into Honeywell's event tracking system. CH2M HILL's requirements can be met by entering an electronic IRF directly into the IRF database. The electronic IRF is found on the CH2M HILL HSE web page under Tools and Forms>Electronic Tools and Forms. If unable to submit an IRF electronically, the SC shall complete the hardcopy IRF provided in Attachment 7 and fax the IRF to the human resources representative (for CH2M HILL employee injuries), the PM, or the HSM (for all other incidents) for database entry. A copy of the hard-copy form should also be sent to Honeywell HSPM. **An IRF for a serious incident shall not be initiated until directed by a representative of the LID.**

When additional or updated information becomes available that was not included in the original IRF the PM shall forward such information to the human resources representative (for CH2M HILL employee injuries) or the HSM (for all other incidents) so that the IRF may be updated. Updates to IRF reports should also be sent to Honeywell HSPM.

CH2M HILL staff shall comply with all applicable statutory incident reporting requirements such as those required by Federal agencies (EPA, OSHA, etc.) and local authorities (police).

10.4 Incident Investigation

Incident investigations are to be initiated and completed as soon as possible, but no later than 72 hours after the incident has occurred. The level and type of investigation will be determined by Honeywell and/or the Honeywell HSPM. **All serious incidents shall be investigated as directed by a representative of the LID.** The HSM/ECC may conduct the investigation directly or may delegate this function to the SC or other party, depending on the extent of the incident and staff availability.

When it is determined that the investigation will be lead by the SC, the Incident Investigation Guideline provided in Attachment 7 shall be followed. Typically, minor incident investigations will be completed by the HSM/ECC by including the investigation facts in the IRF. The HSM/ECC may require completion of a separate investigation report or the Root Cause Analysis Form for more extensive investigations. The HSM/ECC shall ensure that the PM and SC are made aware of investigation findings and all corrective actions, and shall verify that corrective actions are implemented to prevent further incidents.

10.5 Corrective Actions

All corrective actions recommended from the incident investigation report shall be taken to prevent recurrence of the incident. The PM or SC should hold a review meeting to discuss the incident and the corrective actions. The responsible supervisors shall be assigned to carry out the corrective actions and shall inform the SC upon successful implementation of all corrective actions.

11 Emergency Preparedness

(Reference CH2M HILL SOP HSE-106, *Emergency Planning*)

An emergency may be an injury to a worker, an explosion, evacuation, fire, or chemical release. Employees must know what to do if an emergency occurs. This requires pre-planning and communication of these plans to employees.

11.1 Pre-Emergency Planning

The SC shall perform the following pre-emergency planning tasks before starting field activities and coordinate emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.

- Coordinate with property owner and/or review the facility emergency and contingency plans where applicable. Have a copy readily available at the site for review and attach a copy to this HS&E Plan .
- Complete and post the Emergency Contacts form provided in Attachment 8. The SC should confirm that all information provided on the Emergency Contacts form is accurate and appropriately updated.
- Confirm and post evacuation routes, assembly areas and route to hospital.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn)

- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone)
- Communicate emergency procedures to all field staff prior to field activities.
- Post "Exit" signs above exit doors and post "Fire Extinguisher" signs above locations of extinguishers in field trailers.
- Keep areas near exits and extinguishers free of obstructions.
- Designate one vehicle as the emergency vehicle, place hospital directions and map inside, and keep keys in ignition during field activities
- Where appropriate and acceptable to the client, inform emergency room and external emergency response organizations of anticipated types of site emergencies.
- Rehearse the emergency response plan before site activities begin, including driving the route to the hospital.
- Emergency drills should be performed periodically, but at least once per year. Upon completion of each drill, the SC shall evaluate the effectiveness of the emergency plan. Any problems or concerns identified during the evaluation must be corrected immediately.

11.2 Emergency Equipment and Supplies

The SC shall verify that appropriate emergency equipment and supplies are available, as needed, and in proper working order and mark the locations of the equipment on the site map when a map is provided. The following equipment and supplies are typically required:

- Fire Extinguishers
- First aid kit
- Bloodborne pathogen kit
- Personal eye wash station
- Potable water

11.3 Incident Response

The following actions shall be taken in the event of a fire, explosion, or chemical release:

- Shut down CH2M HILL operations and evacuate the immediate area
- Notify appropriate response personnel
- Account for personnel at the designated assembly area(s)
- Assess the need for site evacuation, and evacuate the site as warranted

11.4 Evacuation Procedures

Typical evacuation procedures include the following:

- Evacuation routes and assembly areas will be designated by the SC before work begins

- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation
- The SC and a "buddy" will remain on the site after the site has been evacuated (if safe) to inform local responders of the nature and location of the incident
- The SC will account for all personnel at the assembly area
- The SC will write up a report as soon as possible after the emergency the following the guidelines provided in the Incident Report Section of the HS&E Plan.

11.5 Emergency Medical Treatment

The following actions shall be taken in the event of a medical emergency:

- Get medical attention immediately.
- Notify appropriate emergency response authorities listed on the Emergency Contacts form, as necessary.
- Prevent further injury.
- Initiate first aid and CPR where feasible.
- Make certain that the injured person is accompanied to the emergency room.

The SC will assume control during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room. If the injured is a CH2M HILL employee, the SC or PM must accompany the injured CH2M HILL employee to the emergency room and to any follow-up appointments until the injured is released to full duty.

If there is doubt about whether medical treatment is necessary, or if the injured person is reluctant to accept medical treatment, contact the CH2M HILL medical consultant. When contacting the medical consultant, state that the situation is a CH2M HILL matter, and give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.

The SC shall ensure that all injuries are reported according to the guidelines in the Incident Reporting and Investigation Section of this HS&E Plan.

12 Recordkeeping

(Reference CH2M HILL SOP HSE-15, *Recordkeeping*)

The following records shall be maintained as indicated. Refer to HSE-15 for complete recordkeeping requirements.

Record	Location	Duration
Medical and Exposure Records	Medical & Training Administrator	Employment + 30 years
HS&E Plans	Project File; MTA	Project duration + 5 years
HS&E Training Records	Project File; HandS Database	Employment + 30 years
Environmental Documentation (permits, approvals, manifests)	Project File; HS&E Archive	Project duration + 5 years

13 Attachments

Attachment 1:	Employee Signoff Form – Field Safety Instructions
Attachment 2:	Job Hazard Analysis
Attachment 3:	Project Activity Self-Assessment Checklists
Attachment 4:	Project-Specific Chemical Product Hazard Communication Form
Attachment 5:	Applicable Material Safety Data Sheets
Attachment 6:	Chemical-Specific Training Form
Attachment 7:	Incident Report Form and Root Cause Investigation Information
Attachment 8:	Emergency Contacts
Attachment 9:	Project H&S Forms/Permits
Attachment 10:	Drug Testing Hospital Kit Notice
Attachment 11:	BBLPS Field Forms
Attachment 12:	Biological Hazard Information

Appendix D

Comments and Responses



CH2MHILL

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May 25, 2006

332898.QT.02.20.22.WP

Mr. Richard Ho
New Jersey Remediation Branch
Emergency and Remedial Response Division
United States Environmental Protection Agency, Region 2
290 Broadway, 19th Floor
New York, NY 10007-1866

Subject: Response to March 31, 2006 USEPA Comment Letter Regarding the
Remedial Investigation/Feasibility Study Work Plan and SOW Outline for
Operable Unit 2 (OU2), Quanta Resources Superfund Site, Edgewater,
New Jersey

Dear Richard:

On behalf of Honeywell, CH2M HILL is responding to the March 31, 2006 comment letter received from the EPA concerning the Remedial Investigation/Feasibility Study (RI/FS) Work Plan for Operable Unit 2 (OU2) (Parsons, January 2004) prepared for the Quanta Resources Site in Edgewater, NJ. This letter and the attached comment response table along with Figure 1 constitute Honeywell's formal response to the EPA comment letter. You may recall that resolutions to some of these comments were developed during our May 2, 2006 meeting with EPA, NJDEP, NOAA and BTAG. For ease of review the original EPA comments are attached with annotations indicating which numbered response addresses the comment.

In addition, an outline of the proposed Scope of Work (SOW) is attached for your review. Please forward these documents to the appropriate members of your team.

Honeywell will proceed with the revision of the January 2004 Draft Work Plan upon EPA approval of this response to comments letter and the SOW Outline.

Thank you for your coordination of the May 2nd meeting. If you have any questions or concerns regarding this response, please contact me at (215) 563-4244 extension 340 or Tim Metcalf of Honeywell at 973-455-4107.

Sincerely,
CH2M HILL

Andrew Hopton
OU2 Task Manager

cc: Timothy Metcalf (Honeywell)
Clay Monroe (USEPA)

Bob Hayton (NJDEP)

March 31, 2006

VIA CERTIFIED MAIL
RETURN RECEIPT REQUESTED

Timothy Metcalf, Project Manager
Honeywell International
101 Columbia Road
Morristown, New Jersey 07962

Re: Quanta Resources Superfund Site, Edgewater, New Jersey
Administrative Orders On Consent Index Nos. II-CERCLA-2003-
2012 & -2013

Dear Mr. Metcalf:

The design of the sampling program in the Remedial Investigation Work Plan for Operable Unit 2 (OU2) at the Quanta Resources site does not provide for adequate characterization of the nature and extent of contamination at the site. There are significant concerns regarding the scope of the sampling and analysis proposed for the Hudson River.

Enclosed are comments on the Remedial Investigation Work Plan for OU2 and the Technical Memoranda that were submitted in response to discussions between the QSAG/Honeywell and U.S. Environmental Protection Agency (EPA), New Jersey Department of Environmental Protection (NJDEP), National Oceanic and Atmospheric Administration (NOAA), and U.S. Fish & Wildlife Services (USFWS) at the October 28, 2004 meeting and a subsequent conference call on November 4, 2004.

Please address these comments within 15 (fifteen) work days of receipt of this letter. EPA is available to meet with you to discuss these comments if you wish. Please call me at (212) 637-4372 if you have any questions or to schedule a meeting.

Sincerely yours,

Richard Ho, Remedial Project Manager
New Jersey Remediation Branch

Enclosure

cc: R. Hayton, NJDEP
S. Stoldt, CH2M Hill

Quanta Resources Superfund Site
Comments on Remedial Investigation Work Plan for OU2

Below are specific concerns that have not been adequately addressed in the Technical Memoranda. The memoranda specifically address sediment sampling and target analytes. As studies to be undertaken as part of a baseline ecological risk assessment are not addressed in the work plan, we anticipate that additional work plans will be submitted once the results of proposed sampling is completed.

See
Honeywell
Response
Number 1

Technical Memorandum, Dated December 21, 2004, RI/FS Work Plan, Item #19, Comment #8 (Bullet 4), OU2

This comment addresses collection of sediment samples every 10 feet within a core for chemical characterization after the first two segments. Sampling was proposed for 4 to 6 segments (0-0.5', 2-4', 10-20', 20-30'; 30-40' and 40-50' if necessary) where the final sampling depth is dependent upon field screening information, presence of non-aqueous phase liquid (NAPL), and geotechnical data regarding depth of dredging. The top two depth intervals were selected to meet ecological risk assessment requirements. Below that depth, the selection of a sediment interval sub-sample is proposed based on visual observation and photo-ionization detector (PID) measurements for highest contamination within a segment. The purpose of the lower-most sample is to delineate vertical extent of contamination.

We propose an alternative segmentation scheme that does not leave gaps in the depth profile. Analysis of sediment samples for ecological purposes should be collected from the 0-0.5' and 0.5-1' depth interval and each interval should be homogenized and analyzed separately. The 1-2 foot depth interval should also be homogenized and analyzed. We would also prefer sampling at 2-foot increments down to 10 feet and at greater intervals to depth of contamination. PID & FID measurements and visual observations for highest contamination per sediment interval are valuable in the area closest to the source in part to detect lenses of NAPL. An approach for combining these two efforts should be considered by Honeywell. The purpose of the approach further afield is less apparent and should be explained. Moreover, the proposed approach of setting the lowest sediment interval to 10 feet is unlikely to provide sufficient resolution for determining depth of contamination (DoC) relative to remedial cleanup goals protective of human health and the environment. Will DoC be determined based on PID, on sediment type, absence of NAPL lens, some other characteristic?

Quanta Resources Superfund Site
Comments on Remedial Investigation Work Plan for OU2

See Technical Memorandum, Dated January 12, 2005, RI/FS Work Plan,
Honeywell Item #20, Comment #8 (Bullet 5), OU2
Response Honeywell does not support pesticide analysis of sediment samples
Number 2 based on results of pesticide analysis of site soils. Honeywell
misunderstood the request for pesticide analysis. The request
was limited to sediments used in toxicity testing to avoid
relating any observed acute or chronic toxicity incorrectly.

See Technical Memorandum, Dated January 12, 2005, RI/FS Work Plan,
Honeywell Item #21, Comment #9, OU2
Response An additional sediment coring location, SED-28, is proposed to
Number 3 characterize/delineate inter-bedded NAPL and silt/clay to the
south of the Quanta property. SED-28 could not be identified
from the figures provided. Is it SED-C28? Six additional
surface sediment (0-0.5') samples are proposed upriver of
sediment core locations SED-C22 and SED-C23 for PAHs, PCBs, and 8
metals. Are we correct in assuming that physical analyses will
also be conducted for surface and subsurface sediment?

In order to better comprehend the data collected to date, to more
clearly define the area that needs to be sampled, and to identify
approximate sampling locations, it would be helpful to have all
existing sediment chemistry data in a relational database and in
ArcView (e.g., Access, shape files). We requested that all the
sediment data be summarized in individual contaminant figures
(e.g., total PCBs, individual and total PAHs, individual metals)
showing exceedances of sediment quality guidelines at the October
2004 meeting. These figures will allow for better visualization
of the extent of contamination in Hudson River sediments and in
developing a comprehensive sampling plan. To date we have not
received either a relational database or the GIS files. Having
to work from hard copy maps and data tables therefore hampers our
ability to respond more fully to this memorandum and plot
approximate sampling locations. The number of supplemental
sampling stations is inadequate. We reiterate our request for
gridded sampling or use of some geostatistical approach (e.g.,
FIELDS) to inform the sampling design. If neither of those
approaches is acceptable, we are willing to propose additional
locations to the north and south of the OU2 displayed in Figure
5-1, upon receipt of the information requested above. Cores
rather than grabs should be collected to evaluate current and
historic conditions.

Quanta Resources Superfund Site
Comments on Remedial Investigation Work Plan for OU2

See Technical Memorandum, Dated January 12, 2005, RI/FS Work Plan,
Honeywell Item #22, Comment #10, OU2
Response This addresses supplemental surface sediment sampling to the
Number 4 north of the former gypsum landfill including north of SED-C22
and SED-C23. Elevated concentrations of contaminants in sediment
and groundwater were detected off the former gypsum landfill.
This should be sufficient reason for more detailed
characterization (surface and subsurface) of this area and
upriver. What is the justification for the proposed sampling
locations? Are they in depositional zones, in the vicinity of
CSOs, other sources, etc.?

See Technical Memorandum, Dated January 12, 2005, RI/FS Work Plan,
Honeywell Item #23, Comment #11, OU2
Response Radiometric dating (Be-7, Cs-137) of some cores beyond the
Number 5 bulkhead and in upriver and downriver locations is proposed.
Analysis will be conducted on the top one-half inch to establish
recent deposition. We recommend Be-7 analysis for all cores.
Cs-137 analysis is proposed for 6 high-resolution sediment cores
to establish time dating profiles. Two-centimeter samples will
be collected every 4 inches to the bottom of the core where up to
15 samples will be analyzed per core. It is not clear what the
decision tree is for analyzing sediment intervals or how one will
be confident that the peak has been identified. Is this
segmentation scheme based on depositional rates for this stretch
of the Hudson River? Alternative sampling protocols might
consider different segmentation schemes that might have a better
opportunity of capturing the peak.

See Technical Memorandum, Dated January 12, 2005, RI/FS Work Plan,
Honeywell Item #24, Comment #14, OU2
Response Honeywell proposes five additional surface sample profiles. Two
Number 6 are positioned downriver and three are upriver from the Quanta
Resources Superfund Site. Samples will be analyzed for physical
and chemical data to determine their suitability as background
(or "reference") locations. As expressed at the October 2004,
there is potential for upstream and downstream transport of
site-related contaminants due to the tidal nature of the Hudson
River. The salt wedge can extend as far upstream as Newburg, NY.
Chaky (2003) demonstrated the long-distance transport of
contaminants (2,3,7,8-TCDD) from a lower Passaic River Superfund
Site into the Hudson River as far north as Hastings, NY. These
pieces of evidence suggest that tides and current may be
important in the distribution of site contaminants. We therefore

Quanta Resources Superfund Site
Comments on Remedial Investigation Work Plan for OU2

do not support the objective proposed in this technical memorandum to determine suitability of the 5 stations depicted in Figures 5-1 and 5-2 as reference or background stations.

Additional comments on RI/FS WP OU2 that do not appear to have been previously addressed

See Honeywell Response Number 7 The proposed benthic macroinvertebrate surveys (page 5-4) are only appropriate in areas demonstrated free of product, due to likelihood of physical impairment of the substrate from petroleum product. Additionally, basing the performance of sediment toxicity tests upon results of benthic surveys is inappropriate. First, the benthic macroinvertebrate community in the area is likely to have a high degree of impairment due to ambient conditions as well as site-related impacts and, therefore, should not be used as an indicator for locating sediment toxicity samples. Second, both the macroinvertebrate surveys and the toxicity tests performed during EPA's focused ecological risk assessment (ERA) in 2000 indicated potential adverse effects throughout the area. Third and finally, the condition of the site-related benthic community compared to reference locations is only one factor that will be used in determining the requirement for remediation; it should not be viewed as a binary decision point.

See Honeywell Response Number 8 Mercury is inappropriately eliminated from the proposed analysis (page 5-2). However, as indicated in the WP, the EPA's 2000 ERA clearly identified mercury above relevant benchmarks (Effects Range-Median (ER-M) values) at all sample locations. Mercury should be retained as a COC and included in the analysis proposed in the WP.

See Honeywell Response Number 9 The summary of the existing data (page 3-1; Tables 3-1 and 3-2) does not include the EPA data collected in 2000. These data should be included as they show that concentration of metals in addition to arsenic, chromium, and lead were found to exceed the relevant ecological benchmarks Effects Range Low (ER-L) and, in some cases, even ER-M values. Also, Figure 3-1 should include the USEPA sediment data collected from the mudflat area in 2000. Further, the figure incorrectly notes that the shaded boxes indicate exceedences of one or more soil cleanup criteria; the criteria used for screening the sediment data were the Long et al. (1995) ER-Ls and ER-Ms, which are sediment screening values and not soil cleanup values. The sampling event(s) of the various sediment locations shown on the figure should be

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referenced.

**See
Honeywell
Response
Number 10** The WP presents a brief summary of the analytical testing conducted by the EPA as part of the ERA in 2000 (page 3-4). The WP notes that concentrations of arsenic, copper, lead, mercury, nickel, silver, and zinc were in excess of ER-L values at all six sample locations and that the concentrations of cadmium were in excess of ER-L values at some locations. The concentrations of mercury were in excess of ER-M values at all sample locations and the concentrations of silver were in excess of ER-M values at some locations. Based on these data, the EPA concluded that fish and shellfish that use the tidal flat are at risk from site-related COCs. In addition, the EPA concluded that there appears to be a current and active release of COCs along the base of the bulkhead and at sample Location 1. Based on these data, the scope of the analyses planned for the sediment, especially the metals, needs to be expanded to include other COCs in addition to arsenic, chromium, and lead. It is highly recommended that the full TAL/TCL analyses of the sediments be requested and reported. Without these data, interpretation of the co-located sediment chemistry and benthic macroinvertebrate survey data will be questionable, and may not be meaningful at all.

**See
Honeywell
Response
Number 11** The benthic community testing, and bioassays with amphipods and inland silversides conducted by the EPA should be described. Currently, the WP provides only the overarching conclusions of the EPA 2000 ERA.

**See
Honeywell
Response
Number 12** Sediment pore water collection is not sufficient to assess ecological risks (page 4-3). The benthic and epibenthic community is also directly exposed to sediment, especially through sediment ingestion. Likewise, prey and predators may experience deleterious effects such as reduction in survival and growth, changes in behavior, development of lesions and tumors, suppression of immune functions, alterations of community structure, etc. Sediment sampling must be included in the WP and the investigative approach.

**See
Honeywell
Response
Number 13** The WP proposes the collection of 15 sediment cores; 5 to be collected from each of 3 transects extending from 20 to 400 feet from the wooden bulkhead (page 5-1). Due to the dynamics of the mudflat system adjacent to the site, it is more appropriate to instead employ a more systematic sampling program conducted in a grid formation rather than simply along three transects. Additional sampling locations are warranted regardless of whether

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grids or transects are selected. The area to be sampled should encompass the mudflat area at least to the northerly extent of the arsenic groundwater plume. Based on the 1998 footprint, the plume extends at least to MW-29, which is upriver of the pier recently developed with condominiums and proposed sediment samples SED-C22 and SED-C23. Down-river sampling should extend beyond the extent of the styrene and benzo[a]pyrene plume, such that transects or grids are placed south of MW-109 and proposed sediment samples SED-C16. This would allow for a more definitive delineation of contamination migration from the bulkhead offshore as well as along the shore upriver and downriver of the site. This information will be necessary to properly characterize the full extent of contaminant migration, characterize risk, and to identify specific areas for remediation.

See
Honeywell
Response
Number 14

Four sediment cores are proposed to be collected at locations upriver and downriver of the site (page 5-2), but no details regarding where these locations actually are located are provided. While it is noted in Table 5-3 that these locations will be 1000 feet upriver and downriver of the site, the actual proposed locations should be displayed for review of the WP.

See
Honeywell
Response
Number 15

The WP indicated surface water sampling would be conducted at 6 locations along the shoreline (page 5-3). Four of these samples will be collected adjacent to the site. The fifth sample will be collected south of the Spencer Kellogg office building. The sixth sample will be collected 1,000 feet north of the site, co-located with the upriver sediment sample location. Justification for not collecting a sample 1,000 feet south of the site should be given.

See
Honeywell
Response
Number 16

The WP states one "off-site" benthic macroinvertebrate study will be conducted in a location upriver of the site and one "off-site" survey will be conducted in a location downriver of the site (page 5-4). This statement assumes these areas are not part of the extensive mudflat area directly adjacent to the site. Justification for selection of these locations and support for the conclusion that these upriver and downriver locations are not be impacted by the tidal nature of the site should be presented. It also must be ensured that the benthic conditions of these reference locations are adequately matched to the "on-site" physical conditions to provide the required "comparable communities" (page 5-4).

See
Honeywell
Response
Number 17

The WP notes that to address additional data gaps identified in

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the ERA conducted by USEPA (2000) food chain modeling will be conducted to determine if there is a risk to piscivorous birds and omnivorous mammals that utilize the tidal flat area for foraging (page 5-5). The food chain modeling should also include an evaluation of risks to carnivorous fish and omnivorous birds.

See
Honeywell
Response
Number 18

The activities proposed for the OU2 ERA, similar to those for OU1, will involve only a SLERA initially and if necessary a full BERA will be prepared (page 5-7). EPA proposes that there is already sufficient data available to warrant a BERA. This determination was based on the conclusions of the EPA ERA (2000), including the presence of inorganic and organic contaminants in excess of sediment quality guidelines, acute and chronic effects to the amphipod, *Leptocheirus plumulosus*, and the inland silverside, *Menidia beryllina*, exposed to Hudson River sediments in the vicinity of the site, and a perturbed benthic community characterized by pollution tolerant species. While preliminary work typically part of a SLERA may be required prior to commencing the BERA, the SLERA has essentially already been completed and does not need to be reproduced in its entirety. The collection of sediment samples along a grid pattern adjacent to the site and analysis of samples for the appropriate suite COCs should be undertaken; then a subset of these sample locations representative of a range of concentrations should be further evaluated through toxicity testing (including early life stage fish toxicity tests), tissue analysis (including examination of abnormalities), and benthic community sampling. It must be ensured that locations for toxicity testing and benthic community sampling are not sample locations that contain free product.

See
Honeywell
Response
Number 19

Following are bullets of a generally editorial nature for the OU2 WP:

- Figure 2-1 depicts previous environmental sampling locations in the Hudson River. The figure should clearly indicate the source of the data for the different color-coded locations.
- Page 2-2, Section 2-2, Site History: Paragraph 4 notes that PAHs and metals were elevated in EPA collected samples. Pesticides were also elevated.
- Page 2-5: The authors should state when maintenance dredging of sediments adjacent to the bulkhead ceased and whether or not any such dredging is currently proposed or planned.

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- The references in the text (page 3-1) for the tables and figure are incorrectly referenced in Section 3.2 as Tables 4-1 and 4-1 and Figure 4-1 (there are no such items in the WP), instead of the correct Tables 3-1 and 3-2 and Figure 3-1.

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
1	<p>Tech Memo 12/21/2004, Item #19, Comment #8</p> <p>Issue – Selection of sediment sample depth intervals and total sampling depth.</p>	<p>Sediment grab and core samples will be collected to more fully characterize the nature and extent of contamination. Honeywell proposes the following sampling plan:</p> <p>Grab samples at 50 locations: 0-0.5 ft</p> <p>Core samples at 10 locations: 0-2 ft, 2-4 ft, 4-6 ft, 6-8 ft, 8-10 ft, 12-14 ft, 16-18 ft, 22-24 ft, and 28-30 ft ².</p> <p>The vertical sampling scheme will not leave gaps in the depth profile. Samples will be analyzed for SVOCs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size distribution, and total organic carbon. In addition to sediment sampling, TarGOST™ will be used to delineate NAPL continuously to 50 feet (if feasible).</p> <p>If the depth of contamination (DoC) is not determined after review of the analytical and TarGOST data, options for additional characterization will be discussed with EPA.</p>	Section 5.2.2
2	<p>Tech Memo 1/12/2005, Item #20, Comment #8</p> <p>Issue – Including TCL Pesticide analysis for sediment samples.</p>	Honeywell concurs with the EPA comment and sediment samples used for toxicity testing will be analyzed for pesticides.	Section 5.2.6
3	<p>Tech Memo 1/12/2005, Item #21, Comment #9</p> <p>Issues – SED-28 vs. SED-C28?</p> <p>Will physical analyses be conducted for surface and subsurface sediment samples collected upriver of location SED-C22?</p> <p>Can a relational database (GIS) be provided to better understand contaminant distribution in sediment in the river?</p>	<p>EPA is correct; the work plan figure meant to indicate sampling location SED-C28. However, the sediment sampling design in OU2 and upriver/downriver of OU2 has been revised to utilize a statistically-based grid sampling approach as requested by EPA, and the work plan will be revised accordingly.</p> <p>Physical analyses (grain size, TOC, redox potential) will be conducted on all sediment samples.</p> <p>A relational database (GIS) will be developed as part of the RI</p>	Section 5.2.2

¹ Discussed with USEPA, NJDEP, and NOAA at a project meeting on May 2, 2006.

² As discussed at the May 2, 2006 meeting, vibracore sampling is feasible to 30-foot depth without the need for a large ship or barge.

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
	<p>A sampling design utilizing a grid or geostatistical approach to inform the sampling design is requested.</p> <p>Cores rather than grabs should be collected to evaluate current and historic conditions.</p>	<p>and employed to present and analyze the historic and new data.</p> <p>The revised sample design utilizes a stratified grid approach. A higher density of samples will be collected on a 100 ft grid directly in front of OU1 (Area A) and on a 150 ft grid further away from the site to the north and south along the river (Area B) (see attached Figure 1). In addition, TarGOST will be used in Area 1 and as needed in Area 2 to delineate the extent of NAPL in sediment. In addition, all locations previously sampled using CPT/ROST technology will also be resampled with TarGOST.</p> <p>As described in the response to Comment 1, sediment cores will be collected at a subset of OU2 locations.</p>	
4	<p>Tech Memo January 12, 2005, Item #22, Comment #10</p> <p>Issue – Need for supplemental sampling to the north of the former gypsum landfill and north of sample locations SED – C22 and SED – C23. Provide justification for samples located north of SED-22 and SED-23.</p>	<p>The area north of the former gypsum landfill is adjacent to the Lustrelon and Celotex properties, where a variety of historic industrial activities took place that were unrelated to activities on the Quanta Resources property. The proposed grid sampling in Areas 1 and 2 will help define the lateral distribution and extent of contamination that originated from OU1 and was subsequently transported up or down the Hudson River. Additionally, the grid sampling in Areas 1 and 2 covers areas where plumes of groundwater contamination from OU1 discharge into the river (see the response to Comment 13). Nevertheless, two additional surface sediment samples will be collected north of the former gypsum landfill because previous sampling detected elevated levels of PAHs in this area. These samples will be analyzed for the same list of analytes as all other samples, and will also undergo PAH fingerprinting to determine if the PAHs appear to be related to the coal tar found in OU1.</p>	Section 5.2.2
5	<p>Tech Memo January 12, 2005, Item #23, Comment #11</p> <p>Issue – What are the details for the geochronological sediment sampling proposed in the Work Plan?</p>	<p>Collection of sediment cores for geochronology is no longer planned. Given the history of dredging in OU2, it may be difficult to collect cores for geochronology in undisturbed areas, which is necessary for the determination of net sedimentation rates. Recent geochronology and sedimentation investigations by Klingbeil and Sommerfield in the vicinity of the site will be used in</p>	

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
		conjunction with other information from the literature and RI sample results to infer the depositional history of OU2. Reference: Klingbeil, A.D. and C.K. Sommerfield. 2005. Latest Holocene evolution and human disturbance of a channel segment in the Hudson River Estuary. Marine Geology. 218:135-153.	

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
6	<p>Tech Memo January 12, 2005, Item #24, Comment #14</p> <p>Issue – Location of background samples. EPA is concerned that proposed locations have been impacted by site contamination that is being transported by current and tidal movement.</p>	<p>The contribution of sediment from OU2 to the overall sediment load in the Hudson River estuary is likely to be very small and not measurable at distances of 2000 ft or more from the site. EPA guidance indicates that a reference area should have the same physical, chemical, geological, and biological characteristics as the site being investigated, but should not be affected by activities from the site (EPA, 2002). Potential background areas to be sampled for the OU2 RI are believed to be the best available locations for satisfying the criteria for a reference site given that the impact of site-related contamination is likely to be undetectable. Background sampling in a different watershed would introduce a number of physical, chemical and biological differences that would unnecessarily confound comparisons to site data.</p> <p>Honeywell proposes the use of PAH fingerprinting techniques to confirm the presence or absence of site-related coal tar PAH compounds in sediments from proposed background locations. If site-related PAHs are not present at one or more of these locations, then those locations may be considered for use as reference locations for the BERA. As discussed at the May 2, 2006 project meeting, Honeywell proposes to collect 0-0.5 ft samples from 10 locations (5 upriver and 5 downriver) for consideration as reference locations. The following criteria will be used for the selection of reference samples:</p> <ul style="list-style-type: none"> • Samples will be collected in the same watershed. • Samples will be of similar substrate with the similar grain size and TOC content. • Location will have the similar salinity and hydrodynamic conditions as the study area. • Location will have the similar habitat characteristics. • Samples will not be located near a known outfall or point source of contamination (e.g. known contaminated site). • Regional sediment analytical data will be considered in selecting a reference location. 	<p>Section 5.2.1 and 5.2.2</p>

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
7	<p>Additional Comments Paragraph 1 - Benthic Macroinvertebrate Surveys</p> <p>Issue – Benthic community surveys should not be completed in areas with free product present. And location and performance of sediment toxicity tests should not be based on the benthic community survey results.</p>	<p>Honeywell concurs with EPA's comment. Community surveys will not be completed in areas where NAPL is present. Toxicity testing locations will not be based on the results of the community surveys. Sediment toxicity tests will be set up to test the toxicity of site related contamination over a concentration gradient utilizing sites near the bulkhead and then further away from the site. Toxicity testing will also be completed at the selected reference locations. Details pertaining to this plan will be presented in the Baseline Ecological Risk Assessment (BERA) Work Plan, which will be submitted to EPA 60 days after receipt of the OU2 RI field and after concurrence on reference locations is received from EPA.</p>	Section 5.2.6
8	<p>Additional Comments Paragraph 2 - Mercury as a COPC</p> <p>Issue – Mercury should be included as a COPC.</p>	<p>Mercury will be analyzed as part of the sediment characterization and evaluated as part of the BERA.</p>	Section 5.2.2
9	<p>Additional Comments Paragraph 3 - EPA Data</p> <p>Issue – EPA data should be included in the work plan</p>	<p>A more detailed description of the EPA Ecological Risk Assessment (ERA) and EPA data will be included in the revised Work Plan.</p> <p>Figure 3-1 will be revised, as requested.</p>	Section 5.2.6
10	<p>Additional Comments Paragraph 4 - Analytical Suite for Sediments</p> <p>Issue – Based on metals detected in sediment the sediment samples should be analyzed for full TAL/TCL analyses.</p>	<p>Sediment samples will be analyzed for PAHs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size, and total organic carbon (TOC). Full TCL/TAL analysis will be completed on samples used for toxicity testing.</p>	Section 5.2.2 and 5.2.6
11	<p>Additional Comments Paragraph 5 - EPA Bioassay and Benthic Surveys</p> <p>Issue – The EPA toxicity and benthic survey results should be described in more detail in the Work Plan.</p>	<p>The results from the EPA ERA will be described in detail in the revised Work Plan, as requested.</p>	Section 5.2.6
12	<p>Additional Comments Paragraph 6- Sediment Sampling</p> <p>Issue – Sediment samples should be collected in addition to</p>	<p>Sediment samples, including samples for toxicity testing will be collected to evaluate ecological risk and will be the primary media used for evaluating risk to benthic receptors. The RI/FS text will</p>	Section 5.2

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
	sediment pore water samples.	be clarified to reflect these details. An evaluation of the need for pore water samples will be conducted in discussions with BTAG and EPA ERT.	
13	<p>Additional Comments Paragraph 7 - Sediment Sample Spacing</p> <p>Issue – Sediment samples should be collected systematically on a grid formation. Also sediment samples should be collected upriver to the northerly extent of the arsenic plume, and downriver to beyond the extent of the styrene and BaP groundwater plumes.</p>	As noted in the response to Comment 3, sediment samples will be collected systematically based on a stratified grid sampling design. The areas covered by the grids (Areas A and B, see attached map) include the area offshore of groundwater plumes identified in the OU1 Preliminary Site Characterization Report (CH2M HILL, 2006). Groundwater data for OU1 were presented at the May 2, 2006 project meeting. Styrene and benzo(a)pyrene groundwater plumes were not observed during recent OU1 RI groundwater sampling. Plumes of dissolved-phase naphthalene, benzene and other coal tar-related constituents have been observed historically and recently at OU1. The naphthalene groundwater plume appears to flow directly to the bulkhead, whereas the less concentrated benzene plume and other plumes seem to be moving to the southwest of the bulkhead. The arsenic plume appears to discharge to the river to the north of the bulkhead. The proposed sediment sampling grids extend to the areas offshore of these plumes.	Section 5.2.2
14	<p>Additional Comments Paragraph 8 - Upriver and Downriver Sampling</p> <p>Issue – Locations of up and down river sediment samples should be provided.</p>	The locations were provided in Figure 5-2 in the Tech Memo responding to Item #24, Comment 14, dated January 12, 2005. A new figure will be provided in the revised Work Plan.	Section 5.2.2
15	<p>Additional Comments Paragraph 9 - Surface Water Sampling Locations</p> <p>Issue – Justification should be provided for lack of surface water samples locations south of the site.</p>	Additional surface water samples will be collected both north and south of the site. A total of 10 samples will be collected. Some of these locations were provided in Figure 5-2 from the Technical Memorandum dated January 12, 2005. A revised figure denoting all 10 proposed locations will be provided in the revised Work Plan. As requested, a sample will be collected 1,000 feet downstream of the site.	Section 5.2.3

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
16	<p>Additional Comments Paragraph 10 - Location of Off-Site Benthic Macroinvertebrate Surveys</p> <p>Issue – Proposed locations are not true reference locations and justification is needed to prove that these locations are not impacted by the site.</p>	See Response to Comment # 6. Reference samples will be selected using the criteria listed. If the furthest locations do not indicate the presence of site-related coal tar PAHs it is believed that the locations at distances of 2,000, 3,000, and/or 4,000 feet may serve as reference locations. A habitat/physical survey will be completed to confirm that the mudflats are similar. At this time it is believed that the mudflats in front of the site and to the north and south of the site are similar habitats.	Section 5.2.6 and BERA Work Plan
17	<p>Additional Comments Paragraph 11 - Receptors for Food Chain Modeling</p> <p>Issue – Food chain models should include evaluation of risks to carnivorous fish and omnivorous birds.</p>	As part of the BERA, the food chain modeling will include an evaluation of risk to omnivorous birds such as the mallard duck. Fish will not be modeled using food chain models due to a lack of input parameters for carnivorous fish such as ingestion rates, toxicological data, and the large home range/transient nature of predatory species in this area. To the extent possible, risk to fish will be evaluated by calculating or collecting tissue concentrations from resident species and comparing the measured tissue concentrations to literature based tissue values associated with adverse effects. A BERA Work Plan will be developed subsequent to the evaluation of the OU2 RI data and will detailing the BERA approach.	BERA Work Plan
18	<p>Additional Comments Paragraph 12 - Move to a BERA</p> <p>Issue – The ecological risk assessment process can move directly to a BERA instead of the proposed completion of the SLERA, as sufficient evidence is available indicating ecological risk.</p>	Honeywell agrees with the comment and the ERA will move to a BERA. The problem formulation will be completed and a BERA Work Plan will be prepared and submitted for EPA review.	BERA Work Plan
19	Editorial Comments	Noted editorial comments will be addressed in the revised RI/FS Work Plan.	

Core intervals

0-2 ft
2-4 ft
4-6 ft
6-8 ft
8-10 ft
12-14 ft
16-18 ft
22-24 ft
28-30 ft

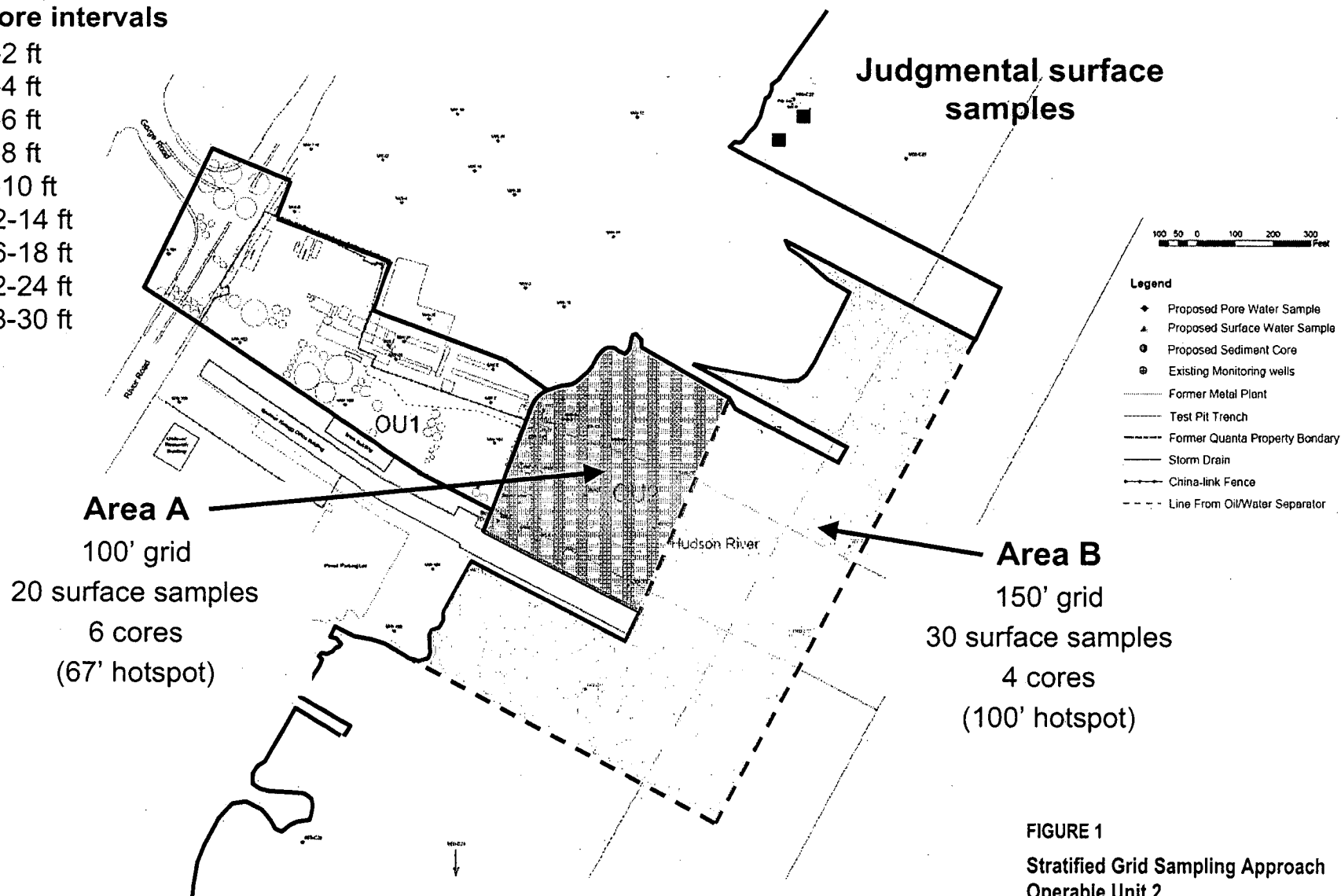


FIGURE 1

**Stratified Grid Sampling Approach
Operable Unit 2**

Quanta Resources Site
Edgewater, New Jersey

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
1	Tech Memo 12/21/2004, Item #19, Comment #8 Issue – Selection of sediment sample depth intervals and total sampling depth.	Sediment grab and core samples will be collected to more fully characterize the nature and extent of contamination. Honeywell proposes the following sampling plan: <ul style="list-style-type: none"> • Grab samples at 50 locations: 0-0.5 ft • Core samples at 10 locations: 0-2 ft, 2-4 ft, 4-6 ft, 6-8 ft, 8-10 ft, 12-14 ft, 16-18 ft, 22-24 ft, and 28-30 ft ². <p>The vertical sampling scheme will not leave gaps in the depth profile. Samples will be analyzed for SVOCs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size distribution, and total organic carbon. In addition to sediment sampling, TarGOST™ will be used to delineate NAPL continuously to 50 feet (if feasible).</p> <p>If the depth of contamination (DoC) is not determined after review of the analytical and TarGOST data, options for additional characterization will be discussed with EPA.</p>	Section 5.2.2
2	Tech Memo 1/12/2005, Item #20, Comment #8 Issue – Including TCL Pesticide analysis for sediment samples.	Honeywell concurs with the EPA comment and sediment samples used for toxicity testing will be analyzed for pesticides.	Section 5.2.6
3	Tech Memo 1/12/2005, Item #21, Comment #9 Issues – SED-28 vs. SED-C28? Will physical analyses be conducted for surface and subsurface sediment samples collected upriver of location SED-C22? Can a relational database (GIS) be provided to better understand contaminant distribution in sediment in the river?	EPA is correct; the work plan figure meant to indicate sampling location SED-C28. However, the sediment sampling design in OU2 and upriver/downriver of OU2 has been revised to utilize a statistically-based grid sampling approach as requested by EPA, and the work plan will be revised accordingly. Physical analyses (grain size, TOC, redox potential) will be conducted on all sediment samples. A relational database (GIS) will be developed as part of the RI	Section 5.2.2

¹ Discussed with USEPA, NJDEP, and NOAA at a project meeting on May 2, 2006.

² As discussed at the May 2, 2006 meeting, vibracore sampling is feasible to 30-foot depth without the need for a large ship or barge.

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Comment Number	EPA Comment	Honeywell Team Response¹	Location of Revision in Work Plan
	<p>A sampling design utilizing a grid or geostatistical approach to inform the sampling design is requested.</p> <p>Cores rather than grabs should be collected to evaluate current and historic conditions.</p>	<p>and employed to present and analyze the historic and new data.</p> <p>The revised sample design utilizes a stratified grid approach. A higher density of samples will be collected on a 100 ft grid directly in front of OU1 (Area A) and on a 150 ft grid further away from the site to the north and south along the river (Area B) (see attached Figure 1). In addition, TarGOST will be used in Area 1 and as needed in Area 2 to delineate the extent of NAPL in sediment. In addition, all locations previously sampled using CPT/ROST technology will also be resampled with TarGOST.</p> <p>As described in the response to Comment 1, sediment cores will be collected at a subset of OU2 locations.</p>	
4	<p>Tech Memo January 12, 2005, Item #22, Comment #10</p> <p>Issue – Need for supplemental sampling to the north of the former gypsum landfill and north of sample locations SED – C22 and SED – C23. Provide justification for samples located north of SED-22 and SED-23.</p>	<p>The area north of the former gypsum landfill is adjacent to the Lustrelon and Celotex properties, where a variety of historic industrial activities took place that were unrelated to activities on the Quanta Resources property. The proposed grid sampling in Areas 1 and 2 will help define the lateral distribution and extent of contamination that originated from OU1 and was subsequently transported up or down the Hudson River. Additionally, the grid sampling in Areas 1 and 2 covers areas where plumes of groundwater contamination from OU1 discharge into the river (see the response to Comment 13). Nevertheless, two additional surface sediment samples will be collected north of the former gypsum landfill because previous sampling detected elevated levels of PAHs in this area. These samples will be analyzed for the same list of analytes as all other samples, and will also undergo PAH fingerprinting to determine if the PAHs appear to be related to the coal tar found in OU1.</p>	Section 5.2.2
5	<p>Tech Memo January 12, 2005, Item #23, Comment #11</p> <p>Issue – What are the details for the geochronological sediment sampling proposed in the Work Plan?</p>	<p>Collection of sediment cores for geochronology is no longer planned. Given the history of dredging in OU2, it may be difficult to collect cores for geochronology in undisturbed areas, which is necessary for the determination of net sedimentation rates. Recent geochronology and sedimentation investigations by Klingbeil and Sommerfield in the vicinity of the site will be used in</p>	

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Comment Number	EPA Comment	Honeywell Team Response ¹	Location of Revision in Work Plan
		conjunction with other information from the literature and RI sample results to infer the depositional history of OU2. Reference: Klingbeil, A.D. and C.K. Sommerfield. 2005. Latest Holocene evolution and human disturbance of a channel segment in the Hudson River Estuary. Marine Geology. 218:135-153.	

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6	<p>Tech Memo January 12, 2005, Item #24, Comment #14</p> <p>Issue – Location of background samples. EPA is concerned that proposed locations have been impacted by site contamination that is being transported by current and tidal movement.</p>	<p>The contribution of sediment from OU2 to the overall sediment load in the Hudson River estuary is likely to be very small and not measurable at distances of 2000 ft or more from the site. EPA guidance indicates that a reference area should have the same physical, chemical, geological, and biological characteristics as the site being investigated, but should not be affected by activities from the site (EPA, 2002). Potential background areas to be sampled for the OU2 RI are believed to be the best available locations for satisfying the criteria for a reference site given that the impact of site-related contamination is likely to be undetectable. Background sampling in a different watershed would introduce a number of physical, chemical and biological differences that would unnecessarily confound comparisons to site data.</p> <p>Honeywell proposes the use of PAH fingerprinting techniques to confirm the presence or absence of site-related coal tar PAH compounds in sediments from proposed background locations. If site-related PAHs are not present at one or more of these locations, then those locations may be considered for use as reference locations for the BERA. As discussed at the May 2, 2006 project meeting, Honeywell proposes to collect 0-0.5 ft samples from 10 locations (5 upriver and 5 downriver) for consideration as reference locations. The following criteria will be used for the selection of reference samples:</p> <ul style="list-style-type: none"> • Samples will be collected in the same watershed. • Samples will be of similar substrate with the similar grain size and TOC content. • Location will have the similar salinity and hydrodynamic conditions as the study area. • Location will have the similar habitat characteristics. • Samples will not be located near a known outfall or point source of contamination (e.g. known contaminated site, which will be mapped in relation to proposed reference locations). • Regional sediment analytical data will be considered in selecting a reference location. 	<p>Section 5.2.1 and 5.2.2</p>

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7	<p>Additional Comments Paragraph 1 - Benthic Macroinvertebrate Surveys</p> <p>Issue – Benthic community surveys should not be completed in areas with free product present. And location and performance of sediment toxicity tests should not be based on the benthic community survey results.</p>	<p>Honeywell concurs with EPA's comment. Community surveys will not be completed in areas where NAPL is present. Toxicity testing locations will not be based on the results of the community surveys. Sediment toxicity tests will be set up to test the toxicity of site related contamination over a concentration gradient utilizing sites near the bulkhead and then further away from the site. Toxicity testing will also be completed at the selected reference locations. Details pertaining to this plan will be presented in the Baseline Ecological Risk Assessment (BERA) Work Plan, which will be submitted to EPA 60 days after receipt of the OU2 RI field and after concurrence on reference locations is received from EPA.</p>	Section 5.2.6
8	<p>Additional Comments Paragraph 2 - Mercury as a COPC</p> <p>Issue – Mercury should be included as a COPC.</p>	<p>Mercury will be analyzed as part of the sediment characterization and evaluated as part of the BERA.</p>	Section 5.2.2
9	<p>Additional Comments Paragraph 3 - EPA Data</p> <p>Issue – EPA data should be included in the work plan</p>	<p>A more detailed description of the EPA Ecological Risk Assessment (ERA) and EPA data will be included in the revised Work Plan.</p> <p>Figure 3-1 will be revised, as requested.</p>	Section 5.2.6
10	<p>Additional Comments Paragraph 4 - Analytical Suite for Sediments</p> <p>Issue – Based on metals detected in sediment the sediment samples should be analyzed for full TAL/TCL analyses.</p>	<p>Sediment samples will be analyzed for PAHs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size, and total organic carbon (TOC). Full TCL/TAL analysis will be completed on samples used for toxicity testing.</p>	Section 5.2.2 and 5.2.6
11	<p>Additional Comments Paragraph 5 - EPA Bioassay and Benthic Surveys</p> <p>Issue – The EPA toxicity and benthic survey results should be described in more detail in the Work Plan.</p>	<p>The results from the EPA ERA will be described in detail in the revised Work Plan, as requested.</p>	Section 5.2.6
12	<p>Additional Comments Paragraph 6- Sediment Sampling</p> <p>Issue – Sediment samples should be collected in addition to</p>	<p>Sediment samples, including samples for toxicity testing will be collected to evaluate ecological risk and will be the primary media used for evaluating risk to benthic receptors. The RI/FS text will</p>	Section 5.2

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	sediment pore water samples.	be clarified to reflect these details. An evaluation of the need for pore water samples will be conducted in discussions with BTAG and EPA ERT.	
13	<p>Additional Comments Paragraph 7 - Sediment Sample Spacing</p> <p>Issue – Sediment samples should be collected systematically on a grid formation. Also sediment samples should be collected upriver to the northerly extent of the arsenic plume, and downriver to beyond the extent of the styrene and BaP groundwater plumes.</p>	As noted in the response to Comment 3, sediment samples will be collected systematically based on a stratified grid sampling design. The areas covered by the grids (Areas A and B, see attached map) include the area offshore of groundwater plumes identified in the OU1 Preliminary Site Characterization Report (CH2M HILL, 2006). Groundwater data for OU1 were presented at the May 2, 2006 project meeting. Styrene and benzo(a)pyrene groundwater plumes were not observed during recent OU1 RI groundwater sampling. Plumes of dissolved-phase naphthalene, benzene and other coal tar-related constituents have been observed historically and recently at OU1. The naphthalene groundwater plume appears to flow directly to the bulkhead, whereas the less concentrated benzene plume and other plumes seem to be moving to the southwest of the bulkhead. The arsenic plume appears to discharge to the river to the north of the bulkhead. The proposed sediment sampling grids extend to the areas offshore of these plumes.	Section 5.2.2
14	<p>Additional Comments Paragraph 8 - Upriver and Downriver Sampling</p> <p>Issue – Locations of up and down river sediment samples should be provided.</p>	The locations were provided in Figure 5-2 in the Tech Memo responding to Item #24, Comment 14, dated January 12, 2005. A new figure will be provided in the revised Work Plan.	Section 5.2.2
15	<p>Additional Comments Paragraph 9 - Surface Water Sampling Locations</p> <p>Issue – Justification should be provided for lack of surface water samples locations south of the site.</p>	Additional surface water samples will be collected both north and south of the site. A total of 10 samples will be collected. Some of these locations were provided in Figure 5-2 from the Technical Memorandum dated January 12, 2005. A revised figure denoting all 10 proposed locations will be provided in the revised Work Plan. As requested, a sample will be collected 1,000 feet downstream of the site.	Section 5.2.3

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16	<p>Additional Comments Paragraph 10 - Location of Off-Site Benthic Macroinvertebrate Surveys</p> <p>Issue – Proposed locations are not true reference locations and justification is needed to prove that these locations are not impacted by the site.</p>	<p>See Response to Comment # 6. Reference samples will be selected using the criteria listed. If the furthest locations do not indicate the presence of site-related coal tar PAHs it is believed that the locations at distances of 2,000, 3,000, and/or 4,000 feet may serve as reference locations. A habitat/physical survey will be completed to confirm that the mudflats are similar. At this time it is believed that the mudflats in front of the site and to the north and south of the site are similar habitats.</p>	<p>Section 5.2.6 and BERA Work Plan</p>
17	<p>Additional Comments Paragraph 11 - Receptors for Food Chain Modeling</p> <p>Issue – Food chain models should include evaluation of risks to carnivorous fish and omnivorous birds.</p>	<p>As part of the BERA, the food chain modeling will include an evaluation of risk to omnivorous birds such as the mallard duck. Fish will not be modeled using food chain models due to a lack of input parameters for carnivorous fish such as ingestion rates, toxicological data, and the large home range/transient nature of predatory species in this area. To the extent possible, risk to fish will be evaluated by calculating or collecting tissue concentrations from resident species and comparing the measured tissue concentrations to literature based tissue values associated with adverse effects. A BERA Work Plan will be developed subsequent to the evaluation of the OU2 RI data and will detail the BERA approach.</p>	<p>BERA Work Plan</p>
18	<p>Additional Comments Paragraph 12 - Move to a BERA</p> <p>Issue – The ecological risk assessment process can move directly to a BERA instead of the proposed completion of the SLERA, as sufficient evidence is available indicating ecological risk.</p>	<p>Honeywell agrees with the comment and the ERA will move to a BERA. The problem formulation will be completed and a BERA Work Plan will be prepared and submitted for EPA review.</p>	<p>BERA Work Plan</p>
19	<p>Editorial Comments</p>	<p>Noted editorial comments will be addressed in the revised RI/FS Work Plan.</p>	

Core intervals

0-2 ft
2-4 ft
4-6 ft
6-8 ft
8-10 ft
12-14 ft
16-18 ft
22-24 ft
28-30 ft

Area A
100' grid
20 surface samples
6 cores

Judgmental surface samples

Area B
150' grid
30 surface samples
4 cores

Note: Ten additional surface samples (0 – 0.5 ft) will be collected (five from upriver and five from downriver) for consideration as reference location samples.

100 50 0 100 200 300 Feet

CH2MHILL

FIGURE 1

Stratified Grid Sampling Approach
Operable Unit 2

Quanta Resources Site
Edgewater, New Jersey

**PROPOSED SCOPE OF WORK
QUANTA RESOURCES OPERABLE UNIT 2 RI/FS**

REVISED RI/FS WORK PLAN	DRAFT RI WORK PLAN (Parsons, 2004)
1. Define horizontal and vertical extent of site-related contamination	
A. TarGOST™ survey to define distribution and limit of coal tar product	N/A (new scope item)
<p>B. OU2 Sediment and Surface Water Sampling</p> <p>Surface sediment samples (0-0.5 ft) at 50 study area grid locations</p> <p>Sediment cores at 10 study area grid locations and analysis of composite samples from the following intervals: 0-2 ft, 2-4 ft, 4-6 ft, 6-8 ft, 8-10 ft, 12-14 ft, 16-18 ft, 22-24 ft, and 28-30 ft</p> <p>Surface sediment samples (0-0.5 ft) from two locations north of the former gypsum landfill</p> <p>Surface water sampling at 10 study area and reference locations</p>	<p>Sediment cores from 15 locations on 3 transects (SED-C1 through SED-C15); samples from the following intervals: 0-0.5 ft, 2-4 ft, 10-20 ft, 20-30 ft, 30-40 ft (if necessary), 40-50 ft (if necessary)</p> <p>Sediment cores from 4 locations east of the 3 transects (SED-C16 through SED-C-19); core sample intervals as identified above</p> <p>Sediment core from 1 location south of transects (SED-C28); core sample intervals as identified above</p> <p>Surface water samples at 6 study area locations</p>
<p>C. Potential Background Area Sediment Sampling</p> <p>Surface sediment samples (0-0.5 ft) from five locations upstream of OU2 and five locations downstream of OU2</p>	<p>Sediment cores from 4 locations upriver and downriver of OU2 (SED-C20 though SED-C23); core sample intervals as identified above</p> <p>Surface sediment samples (0-0.5 ft) from 6 locations upriver of OU2 (SED-C24 though SED-C29)</p> <p>Surface sediment samples (0-0.5 ft) from 4 locations downriver of OU2 (SED-C30 though SED-C33)</p>

REVISED RI/FS WORK PLAN	DRAFT RI WORK PLAN (Parsons, 2004)
<p>D. Sample Analysis</p> <p>Analysis of all samples for SVOCs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size distribution, and total organic carbon</p> <p>Subset of samples to be analyzed for extended list of PAH compounds for fingerprinting</p> <p>Subset of samples to be analyzed for geotechnical parameters (moisture content and bulk density, Atterberg limits, self-weight consolidation, permeability, and column settling tests)</p>	<p>Analysis of all samples for PAHs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, and zinc</p> <p>Subset of cores to be analyzed for radioisotope dating (Cs-137, Be-7)</p> <p>Subset of samples to be analyzed for geotechnical parameters (grain size, Atterberg limits, specific gravity, water content, organic content, bulk density, self weight consolidation, permeability)</p>
2. Ecological Risk Assessment (scope TBD in BERA Work Plan)	
<p>A. Sediment Sampling</p> <p>Surface sediment sampling at study area and reference locations associated with toxicity testing.</p>	<p>Not Specified</p>
<p>B. Surface Water Sampling</p> <p>Pore water and seepage measurement work TBD based on discussions with BTAG/ERT</p> <p>Possible additional surface water sampling in support of water column bioassay work.</p>	<p>Pore water samples at 6 study area locations (collocated with surface water locations)</p> <p>Seepage measurements at 3 of the 6 surface water/pore water sample locations</p>
<p>C. Benthic Surveys</p> <p>Benthic surveys at study area and reference locations</p>	<p>Benthic surveys at 2 onsite and 2 offsite locations</p>
<p>D. Bioassay Testing</p> <p>Bioassay testing for multiple study area and reference locations</p>	<p>Bioassay testing if community survey indicated significant difference in onsite and offsite communities.</p>
<p>E. Food Chain Modeling</p> <p>Food chain modeling at study area and reference locations. Collection of field tissue samples if applicable.</p>	<p>Food chain modeling at study area and reference locations. If risk is indicated by models possible collection of field tissue samples.</p>

REVISED RI/FS WORK PLAN	DRAFT RI WORK PLAN (Parsons, 2004)
3. Human Health Risk Assessment	
<p>A. Baseline Human Health Risk Assessment</p> <p>Use of sediment and surface water samples from RI to complete a BHHRA. BHHRA to include Exposure Scenario and Assumptions memo and a Pathway Analysis Report (PAR) as interim deliverables. Includes evaluation of ingestion pathway using modeled fish or crab concentrations.</p>	<p>Completion of BHHRA including the same interim deliverables.</p>

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GENERAL COMMENTS OU2 RI/FS WORK PLAN

Comment Number	EPA Comment	Honeywell Team Response	Location of Revision in Work Plan
1	The OU2 data needs to include more stratigraphic and groundwater characterization data. More monitoring wells and/or piezometers and sediment borings need to be added that are specifically screened through all the hydrogeologic units. The horizontal and vertical extent and orientation of confining layers and aquifers have to be better delineated within and surrounding the area of suspected river bottom contamination. Provide additional groundwater elevation data and potentiometric maps and identify undetected horizontal and vertical perturbations of the groundwater flow under the river.	Additional monitoring well and soil borings have been completed as part of the ongoing OU1 Remedial Investigation/Feasibility Study (RI/FS) activities and the results were reported in the Draft PSCR (CH2M HILL February, 2006). Additional delineation work is planned for OU1 as part of supplemental RI/FS field activities (the Supplemental RI/FS Work Plan (CH2M HILL, 2006) was submitted to EPA on July 28, 2006. All of the additional OU1 investigative work will address the concerns related to the vertical and horizontal extent and orientation of confining layers and water-bearing zones immediately adjacent to the river. Results of this delineation work will be presented the OU1 RI Report. As part of the OU2 RI, the stratigraphy of the tidal flat in off-shore locations in OU2 is being investigated with 14 Vibracore locations. In addition, further investigation of the groundwater to surface water pathway will be completed as part of the OU2 Baseline Ecological Risk Assessment (BERA).	Not Applicable (NA), see OU1 RI and OU2 BERA Work Plan (when completed)
2	<p>The most critical geologic and hydrologic information that need to be collected include:</p> <ul style="list-style-type: none"> • The stratigraphy, especially the thickness, lateral extent, continuity of confining units and the presence of depositional features such as channel deposits; • The identification of geologic features that may form preferential pathways; • The hydraulic properties of the aquifers and confining layers; • The spatial distribution of physical and hydraulic properties of the strata layers from the sediments down to the bedrock; • The temporal variability of the hydrologic conditions including tidal effects; • The comprehensive mapping of the groundwater discharge and possible recharge areas. 	See response to Comment 1 above.	NA

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3	Several stratigraphic cross sections are needed across the site from the aquifer recharge areas extending into the river. These cross sections should intersect all the known zones of DNAPLs, potential groundwater discharge zones, known contaminant plumes and aligned both perpendicular and parallel to the general groundwater flow. The stratigraphic data has to be from strategically placed monitoring wells, geoprobes and piezometers which are screened in all the confining layers, impacted aquifers and especially in the river beyond the area of known contamination.	See response to Comment 1. Additional stratigraphic data have or are currently being collected as part of the OU1 RI/FS. Based on the data collected as part of the OU1 RI and Supplemental Investigation, aquifer characteristics and recharge areas will be identified. This information will be used to design the groundwater surface water pathway investigation that will be completed in support of the OU2 BERA.	NA
4	An initial groundwater investigation of the chemical and geochemical contaminant indicators, such as redox, pH, and/or oxygen levels, over a wider area of the river bottom is needed. Additional sediment cores could be placed at locations further up and down the river and ideally orientated in a grid pattern extending beyond where oxygen reduction potential changes are minimal. The extrapolated distribution of the Oxidation Reduction Potential (ORP) values indicate the extent of VOC degradation and roughly the outward limit of the groundwater contamination (Figure 3.6). Since many of the groundwater contaminants are dissolved VOCs, PAHs and PCBs these ORP values may also reflect the over all extent of the DNAPL migration under the river.	Additional sediment samples will be collected in front of the site and both up and downstream of the site. An evaluation of the groundwater and surface water interface will be completed as part of the OU2 BERA. A groundwater-surface water study approach developed by Dr. Mark Greenberg (EPA ERT) will be evaluated for potential application at OU2. This approach would use measurements of temperature, conductivity, salinity, and hydrologic data collected as part of the OU1 RI and in the river to identify upwelling zones in the river bed.	Section 5.2.2
5	An effective pore water sampling plan requires that the zones of groundwater discharge be adequately delineated. The zones of groundwater discharge could be identified by using a seepage meter to measure the conductivity and temperature of the pore water along the river bottom. This conductivity and temperature data can then be compared to values found in the groundwater migrating from the site. Any pore water samples which match conductivity and temperatures of the known groundwater values would identify the zones of groundwater discharge. The pore water in these discharge areas can then be sampled for metals, PAHs and VOCs to determine the extent of contaminated groundwater migrating into the river. To more accurately measure the groundwater impacts to the river water, the above pore water sampling must be coordinated with the surface water sampling.	Pore water sampling will not be done as part of the current OU2 RI WP scope. The groundwater to surface water pathway will be evaluated as part of the OU2 BERA and will be described in the BERA work plan.	Section 5.2.4 and 5.2.5

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6	The proposed surface water sampling is probably not coordinated with the groundwater discharge areas. It is likely that the six sampling locations will not intercept the maximum groundwater discharge areas, which are occurring over a large section of the river bottom adjacent to the site. The existing near shore surface water data is inadequate for such an extensive length of the river that is prone to contaminated groundwater discharge. More surface water sampling must be performed beyond the known zones of groundwater discharge. This additional surface water data should be collected at points along additional transects oriented parallel to the shoreline and extending between the known seepage points	See response to Comments 3, 4, and 5. A groundwater/surface water study will be completed as a part of the OU2 BERA.	Section 5.2.3, 5.2.4, 5.2.5
7	Additional seep sampling need to be conducted along more areas of the river bank that may be impacted by groundwater discharge from the site. Contaminated ground water migrating from the upland area could potentially be discharging from the river bank and river bottom beyond the immediate bulkhead area. The seep sampling and coordinated groundwater sampling were supposed to be conducted along the entire river bank that also is prone to groundwater discharge from the contaminated areas beyond the OU1 area.	Seeps have not been noted along the banks by visual observation during the 2005 and 2006 OU1 RI work. However groundwater discharge areas will be located as part of a separate GW/SW study during the OU2 BERA.	
8	Page 5-2: The rationale and description of sampling depths is unclear.		
	<ul style="list-style-type: none"> BTEX sampling is targeted for only the 6-12 inch horizon, with no other parameters run for this depth interval. EPA presumes that all parameters would be run for each depth sampled. Please justify rationale or include all parameters at each depth interval. 	<ul style="list-style-type: none"> Sediment samples will be analyzed for VOCs, SVOCs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size, and total organic carbon (TOC). Full TCL/TAL analysis will be completed on samples used in support of testing completed under the BERA (toxicity testing, benthic community surveys) . 	Section 5.2.2

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	<ul style="list-style-type: none"> Please give the rationale for sampling at 0-6 inches and at 6-12 inches 	<ul style="list-style-type: none"> Samples will be collected at 0-6 inches at 77 locations and at 14 core locations samples will be collected from 0.5-1 ft, 1-2 ft, 2-4 ft, 4-6 ft, 6-8 ft, 8-10 ft, 12-14 ft, 16-18 ft, 22-24 ft, and 28-30 ft. The 0-0.5, 0.5-1.0, and 1-2 ft sample intervals were selected in consultation with EPA in a meeting on July 13, 2006 to provide data to support the BERA. 	Section 5.2.2
	<ul style="list-style-type: none"> Surface samples may not represent the actual impacts. As previously noted, contaminant discharge to the surface is concentrated at certain locations where contamination is visible. Surface sediment sampling needs to include some of these areas, which are visible proximal to shore at low tide. 	<ul style="list-style-type: none"> Surface and subsurface sediment samples will include areas where there are visible seeps (blossoms of NAPL) in the tidal flat areas. 	Section 5.2.2
	<ul style="list-style-type: none"> The third sample interval is given as just below the maximum concentration in the previous core. Many of these locations are not at a previously sampled location, nor is sampling just below a previous interval the best approach. Samples shall be targeted to the areas suspected to contain the highest concentrations. For PAHs, this may be visible. For BTEX, it may be determined using a PID. For other constituents, such as metals, there may not be a clear indication in the field. Samples also need to be collected to clearly show the vertical distribution of contamination. Subsequently, the work plan should include one sample per each 10 feet of contaminated sediment, targeting the horizon in each interval that is deemed likely to contain the highest concentrations. In addition, surface samples and a deep sample at a horizon which is presumed to be clean should also be included. 	<ul style="list-style-type: none"> Subsurface sediment samples will be collected at the following intervals: 0-0.5 ft, 0.5-1 ft, 1-2 ft, 2-4 ft, 4-6 ft, 6-8 ft, 8-10 ft, 12-14 ft, 16-18 ft, 22-24 ft, and 28-30 ft, as presented in the DQOs and agreed on in the meetings. Additional delineation will be completed using TarGOST with confirmatory samples collected at depth, as practical. 	Section 5.2.2
	<ul style="list-style-type: none"> Pesticides need to be added to the sample analysis suite. 	<ul style="list-style-type: none"> Pesticides will be analyzed when sediments are collected for toxicity testing and benthic community surveys as part of the BERA. Pesticides are not a COPC at OU1 and therefore, OU2-wide analysis for these constituents is not appropriate. 	NA

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9	The sediment sample locations do not adequately investigate the horizontal extent of contamination. Additional sampling is needed in a number of areas. Limited existing data to the south of the Spencer Kellogg pier show that this is an area that is likely impacted, as is the area southwest of MW-109. The data include CPT locations at which product was detected without sample collection. Although the text argues that this is not attributable to the site, the presence of product in this area suggests a connection.	Samples will be collected on a grid. The A portion of the grid extends to the south of the Spencer Kellogg pier. Additional samples will be collected further downstream of the grid.	Section 5.2.2
10	Additional sampling is also needed in areas to the north. A line of samples should be collected south of the gypsum landfill to complete delineation proximal to the Quanta property. Also, more extensive sampling is required to delineate contamination further to the north, where SED-22 and SED-23 are to be collected.	Samples will be collected on a grid that extends from in front of the site and up to and around the gypsum landfill. Five additional samples are proposed to the north of the gypsum landfill.	Section 5.2.2
11	Page 5-2: The radiometric dating has the potential to yield information on sedimentation rates and the dating of sediment horizons. Details as to which isotopes will be used need to be included in the work plan. Presumably, only surficial samples would be analyzed for beryllium-7, and these results would be used to set the time zero concentration of lead-210. Information on the date of the last dredging of the site needs to be included as well so that the approach and results can be placed in proper context. The efficacy of sampling for cesium-137 will be tied to this information as well, as the cesium data acts essentially as a marker bed. Again, the work plan should indicate exactly what will be done, rather than indicating that samples will be run for one or more parameters. In addition, please indicate to what depth the radiometric profiling will be conducted, presumably 50 feet.	The Work Plan will be revised to specify more detail on the sampling and use of radiometric dating results. Additional details will be provided in the Work Plan on sampling for radiometric dating. These results are intended to supplement the chemical results and to provide information that will determine sedimentation rates and dating of sediment horizons.	Section 5.2.2

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12	It is not clear that all the data uses given in the work plan are appropriate. While the data may be able to indicate sedimentation rates, as well as date depth horizons, it is not clear that this will indicate what contamination present is attributable to background versus the site. Also, where DNAPL is an issue, it may be that contaminants have migrated vertically. As a result, it could be possible to have older sediments contaminated by more recent sources. Other contaminants might also migrate with DNAPL, presenting a similar problem.	As discussed in the May 2 and July 13, 2006 meetings and described in the revised Work Plan, samples will be collected up and downstream of the site. Selected samples will be analyzed using fingerprinting techniques to determine if site-related coal tar is present. Data from the upriver and downriver locations will be evaluated to determine regional background levels of chemicals in the lower Hudson River.	Section 5.2.1, 5.2.2
13	Ultimately, determining what contaminants are attributable to background will have to be based on sampling in background areas and the empirical distribution of contaminants at the site. While sedimentation rates and stratigraphic dating may add to the picture, it will not be given the same weight as the chemical data.	The sampling approach has been revised to investigate background concentrations of chemicals in the lower Hudson River; these data will be used to help establish the distribution of site-related contaminants.	Section 5.2.1, 5.2.2
14	The work plan needs to include a more detailed approach to establishing background. Existing data from the Hudson can be used if it can be shown that this is appropriate. Otherwise, background sampling locations should be selected and justified as providing representative data. Locations SED-C20 and SED-C21 may or may not be appropriate for this purpose, as tidal effects may have mobilized contamination from closer to the site sources. A better location should be selected. EPA guidance on appropriate background studies should be followed. Two such references are: Determination of background concentrations of inorganics in soils and sediments at hazardous waste sites, EPA 1995; and Statistical tests for background comparison at hazardous waste sites, EPA, 1998. Note that the results of the background study are likely to have implications for contaminant delineation activities.	A more detailed approach for establishing background in the lower Hudson River has been incorporated into the Work Plan. EPA guidance indicates that a reference area should have the same physical, chemical, geological, and biological characteristics as the site being investigated, but should not be affected by activities from the site (EPA, 2002). Potential background areas to be sampled for the OU2 RI are believed to be the best available locations for satisfying the criteria for a reference site. Once the results are available for background locations in the Hudson River, the data will be presented to EPA and the suitability of the locations for use as reference locations will be considered.	Section 5.2.1
15	Section 5.2.3: Surface water samples should be collected from the base of the water column, rather than the middle. This is the area most likely to be impacted. In addition, 3 background samples should be added and co-located with sediment background samples.	Surface water samples will be collected as part of the SW/GW pathway investigation completed to support the BERA, and will be described in the OU2 BERA Work Plan. This work will be completed after additional hydrogeologic characterization work has been completed for OU1.	NA

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16	Section 5.2.4: It is not clear that pore water samples, as planned, will provide a good means of extrapolating surface water concentrations. The oily discharge from seeps may represent a much greater input of contaminants. As the seeps are localized, pore water samples as located may not be representative. Subsequently, at least 3 additional pore water locations should be targeted towards visible surface discharge points in the inter-tidal mud flat.	Pore water and surface water samples will be collected as part of a GW/SW study completed as a part of the BERA.	NA
17	Please clearly indicate what section of the report will present the conclusions of the baseline human health risk assessment.	The BHHRA will be submitted as a separate document after the RI is completed. Fish tissue data is needed to complete the BHHRA and this data will not be collected until the BERA is completed. The Work Plan has been revised accordingly.	Section 5.7
18	Page 6-2, Section 6.3: Please note that the NJDEP SCC are not ARARs. These criteria are TBCs. Soil remediation goals shall be developed following the guidance outlined in RAGS Part B.	The Work Plan has been revised accordingly.	Section 6.3
19	Section 5.2: This section does not contain any information on fish tissue collection and analysis. Due to the bioaccumulation and biomagnification potential of several of the contaminants such as PAHs, PCBs, and metals and the designation of the water body as a fishery, the human health evaluation must include ingestion of fish; and fish tissue sampling is strongly recommended.	As discussed in the meetings on May 2, and July 13, 2006, resident fish and crab tissue data will be collected at the site and from reference areas as part of the BERA. Tissue samples will be collected from non-migratory resident fish. Migratory sport fish will not be collected. This data will be used in the BHHRA.	Section 5.7
20	Page 5-6, Section 5.7: Please revise the text so that the term "COC" and "COPC" are used correctly	The Work Plan has been revised accordingly.	
21	Page 5-9: Please clearly indicate what section of the report will present the conclusions of the baseline human health risk assessment.	Refer to the response to Comment 17.	
22	Page 6-2, Section 6.3: Please note that the NJDEP SCC are not ARARs. These criteria are TBCs. Soil remediation goals should be developed following the guidance outlined in RAGS Part B. These values will then be compared to the NJDEP SCC.	Refer to the response to Comment 18.	

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Ecological Comments			
23	The proposed benthic macroinvertebrate surveys (page 5-4) are only appropriate in areas demonstrated free of product, due to likelihood of physical impairment of the substrate from petroleum product. Additionally, basing the performance of sediment toxicity tests upon results of benthic surveys is inappropriate. First, the benthic macroinvertebrate community in the area is likely to have a high degree of impairment due to ambient conditions as well as site-related impacts and, therefore, should not be used as an indicator for locating sediment toxicity samples. Second, both the macroinvertebrate surveys and the toxicity tests performed during the EPA's focused ecological risk assessment (ERA) in 2000 indicated potential adverse effects throughout the area. Third and finally, the condition of the site-related benthic community compared to reference locations is only one factor that will be used in determining the requirement for remediation; it should not be viewed as a binary decision point.	As discussed in the 5/2 and 7/13 meetings a BERA will be conducted after contamination at the site has been delineated in more detail. Honeywell concurs with EPA's comment. Community surveys will not be completed in areas where NAPL is present. Toxicity testing locations will not be based on the results of the community surveys. Sediment toxicity tests will be set up to test the toxicity of site related contamination over a concentration gradient utilizing sites near the bulkhead and then further away from the site. Toxicity testing will also be completed at the selected reference locations. Details pertaining to this plan will be presented in the Baseline Ecological Risk Assessment (BERA) Work Plan, which will be submitted to EPA 60 days after receipt of the OU2 RI field and after concurrence on reference locations is received from EPA.	Sections 5.2.6 and 5.8
24	Mercury is inappropriately eliminated from the proposed analysis (page 5-2). However, as indicated in the work plan, EPA's 2000 ERA clearly identified mercury above relevant benchmarks (Effects Range-Median (ER-M) values) at all sample locations. Mercury shall be retained as a COC and included in the analysis.	The Work Plan has been revised to include mercury in the analyses of the sediment samples.	Section 5.2.2
25	The summary of the existing data (page 3-1; Tables 3-1 and 3-2) does not include the EPA data collected in 2000. This data needs to be included as they show that concentration of metals in addition to arsenic, chromium, and lead were found to exceed the relevant ecological benchmarks Effects Range Low (ER-L) and, in some cases, even ER-M values. Also, Figure 3-1 should include the EPA sediment data collected from the mudflat area in 2000. Further, the figure incorrectly notes that the shaded boxes indicate exceedences of one or more soil cleanup criteria; the criteria used for screening the sediment data were the Long <i>et al.</i> (1995) ER-Ls and ER-Ms, which are sediment screening values and not soil cleanup values. The sampling event(s) of the various sediment locations shown on the figure need to be referenced.	The data collected as part of the EPA ERA conducted in 2000 is presented as Table 3.3, 3.4, and 3.5. Figure 3-1 has been revised for the WP to include the EPA data. As part of the RI a GIS will be established for OU2 and new and existing data will be plotted on the map.	Section 3.4, Figure 3-1

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26	Page 3-4: The work plan notes that concentrations of arsenic, copper, lead, mercury, nickel, silver, and zinc were in excess of ER-L values at all six sample locations and that the concentrations of cadmium were in excess of ER-L values at some locations. The concentrations of mercury were in excess of ER-M values at all sample locations and the concentrations of silver were in excess of ER-M values at some locations. Based on these data, EPA concluded that fish and shellfish that use the tidal flat are at risk from site-related COCs. In addition, EPA concluded that there appears to be a current and active release of COCs along the base of the bulkhead and at sample Location 1. Based on these data, the scope of the analyses planned for the sediment, especially the metals, needs to be expanded to include other COCs in addition to arsenic, chromium, and lead. Full TAL/TCL analyses of the sediments is required. Without this data, interpretation of the co-located sediment chemistry and benthic macroinvertebrate survey data will be questionable, and may not be meaningful at all.	Sediment samples will be analyzed for VOCs, PAHs, PCBs, arsenic, chromium, lead, copper, mercury, nickel, silver, zinc, grain size, and total organic carbon (TOC). Full TCL/TAL analysis will be completed on samples used for toxicity testing.	Section 5.2.2 and 5.2.6
27	The benthic community testing, and bioassays with amphipods and inland silversides conducted by the EPA should be described. Currently, the work plan provides only the overarching conclusions of the EPA 2000 ERA.	The work conducted by the EPA in 2000 will be described in additional detail in the work plan.	Section 3.4
28	Sediment pore water collection is not sufficient to assess ecological risks (page 4-3). The benthic and epibenthic community is also directly exposed to sediment, especially through sediment ingestion. Likewise, prey and predators may experience deleterious effects such as reduction in survival and growth, changes in behavior, development of lesions and tumors, suppression of immune functions, alterations of community structure, etc. Sediment sampling must be included in the work plan and the investigative approach.	Shallow Sediment samples will be collected on a grid from 63 locations near the site from 0-6 inches and at 14 locations from 0-6, 6-12 inches, and from 1 to 2 feet. Additional sediment sampling will be completed as part of the BERA in support of toxicity testing and benthic fauna surveys. All of this data will be used to evaluate exposure of benthic receptors.	Section 5.2.2

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29	<p>The work plan proposes the collection of 15 sediment cores; 5 to be collected from each of 3 transects extending from 20 to 400 feet from the wooden bulkhead (page 5-1). Due to the dynamics of the mudflat system adjacent to the site, it is more appropriate to instead employ a more systematic sampling program conducted in a grid formation rather than simply along three transects. Additional sampling locations are warranted regardless of whether grids or transects are selected. The area to be sampled shall encompass the mudflat area to the northerly extent of the arsenic groundwater plume at the minimum. Based on the 1998 footprint, the plume extends at least to MW-29, which is upriver of the pier recently developed with condominiums (The Promenade) and proposed sediment samples SED-C22 and SED-C23. Downriver sampling should extend beyond the extent of the styrene and benzo[a]pyrene plume, such that transects or grids are placed south of MW-109 and proposed sediment samples SED-C16. This would allow for a more definitive delineation of contamination migration from the bulkhead offshore as well as along the shore upriver and downriver of the site. This information is needed to properly characterize the full extent of contaminant migration, characterize risk, and to identify specific areas for remediation.</p>	<p>As noted in the response to Comment 3, sediment samples will be collected systematically based on a stratified grid sampling design. The areas covered by the grids (Areas A and B, see attached map) include the area offshore of groundwater plumes identified in the OU1 Preliminary Site Characterization Report (CH2M HILL, 2006). Groundwater data for OU1 were presented at the May 2, 2006 project meeting. Styrene and benzo(a)pyrene groundwater plumes were not observed during recent OU1 RI groundwater sampling. Plumes of dissolved-phase naphthalene, benzene and other coal tar-related constituents have been observed historically and recently at OU1. The naphthalene groundwater plume appears to flow directly to the bulkhead, whereas the less concentrated benzene plume and other plumes seem to be moving to the southwest of the bulkhead. The arsenic plume appears to discharge to the river to the north of the bulkhead. The proposed sediment sampling grids extend to the areas offshore of these plumes.</p>	Section 5.2.2
30	<p>The work plan proposes that four sediment cores will be collected at locations upriver and downriver of the site (page 5-2), but no details regarding where these locations actually are located are provided. While it is noted in Table 5-3 that these locations will be 1000 feet upriver and downriver of the site, the actual proposed locations need to be presented.</p>	<p>20 sediment samples will be collected up and down river of the site. Proposed locations are presented in Figure 5.2. See also response to Comment 14 above.</p>	Section 5.2.1 and 5.2.2
31	<p>The work plan indicates that surface water sampling will be conducted at 6 locations along the shoreline (page 5-3). Four of these samples will be collected adjacent to the site. The fifth sample will be collected south of the Spencer Kellogg office building. The sixth sample will be collected 1,000 feet north of the site, co-located with the upriver sediment sample location. Justification for not collecting a sample 1,000 feet south of the site must be given.</p>	<p>Surface water samples will be collected as part of a later investigation phase (as part of the BERA) and will be located based on groundwater upwelling zones.</p>	NA, will be presented in the BERA WP

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32	The text states one "off-site" benthic macroinvertebrate study will be conducted in a location upriver of the site and one "off-site" survey will be conducted in a location downriver of the site (page 5-4). This statement assumes these areas are not part of the extensive mudflat area directly adjacent to the site. Justification for selection of these locations and support for the conclusion that these upriver and downriver locations are not be impacted by the tidal nature of the site need to be presented. It also must be ensured that the benthic conditions of these reference locations are adequately matched to the "on-site" physical conditions to provide the required "comparable communities" (page 5-4).	See updated response #14. After reference areas are established and approved by EPA these locations will be used in the BERA. Justification and site data will be provided for evaluating the use of these locations.	NA will be presented in the BERA WP
33	The text notes that to address additional data gaps identified in the ERA conducted by EPA (2000), food chain modeling will be conducted to determine if there is a risk to piscivorous birds and omnivorous mammals that utilize the tidal flat area for foraging (page 5-5). The food chain modeling shall also include an evaluation of risks to carnivorous fish and omnivorous birds.	As part of the BERA, the food chain modeling will include an evaluation of risk to omnivorous birds such as the mallard duck and omnivorous mammals such as the raccoon. Fish will not be modeled using food chain models due to a lack of input parameters for carnivorous fish such as ingestion rates, toxicological data, and the large home range/transient nature of predatory species in this area. To the extent possible, risk to fish will be evaluated by calculating or collecting tissue concentrations from resident species and comparing the measured tissue concentrations to literature based tissue values associated with adverse effects. A BERA Work Plan will be developed subsequent to the evaluation of the OU2 RI data and will detail the BERA approach.	NA, BERA approach will be presented in the BERA WP
34	The activities proposed for the OU2 ERA, similar to those for OU1, will involve only a SLERA initially and if necessary a full BERA will be prepared (page 5-7). EPA believes that there is sufficient data available to warrant a BERA. This determination is based on the conclusions of the EPA ERA (2000), including the presence of inorganic and organic contaminants in excess of sediment quality guidelines, acute and chronic effects to the amphipod, <i>Leptocheirus plumulosus</i> , and the inland silverside, <i>Menidia beryllina</i> , exposed to Hudson River sediments in the vicinity of the site, and a perturbed benthic community characterized by pollution tolerant species. While preliminary work typically part of a SLERA may be required prior to commencing the BERA, the SLERA has essentially already been	Honeywell team concurs that the ERA process should move to the BERA stage. The problem formulation will be completed and a BERA WP will be prepared and submitted for EPA and BTAG review.	Section 5.8

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	completed and does not need to be reproduced in its entirety. The collection of sediment samples along a grid pattern adjacent to the site and analysis of samples for the appropriate suite COCs should be undertaken; then a subset of these sample locations representative of a range of concentrations should be further evaluated through toxicity testing (including early life stage fish toxicity tests), tissue analysis (including examination of abnormalities), and benthic community sampling. It must be ensured that locations for toxicity testing and benthic community sampling are not sample locations that contain free product. Revise the work plan.		
35	Following are bullets of a generally editorial nature:		
	<ul style="list-style-type: none"> Figure 2-1 depicts previous environmental sampling locations in the Hudson River. The figure should clearly indicate the source of the data for the different color-coded locations. 	<ul style="list-style-type: none"> The samples located in the Hudson River were collected by either GeoSyntec in 1999-2000 or EPA in 2000. These results are presented on Figure 3-1 with footnotes indicating the source of the data. Figure 2-1 will not be revised. Instead please refer to Figure 3-1. 	Figure 3-1
	<ul style="list-style-type: none"> Page 2-2, Section 2-2, Site History: Paragraph 4 notes that PAHs and metals were elevated in EPA collected samples. Pesticides were also elevated. 	<ul style="list-style-type: none"> Four pesticides were detected in the EPA samples; these will be included in the site history information. 	Section 3.4
	<ul style="list-style-type: none"> Page 2-5: Identify when maintenance dredging of sediments adjacent to the bulkhead ceased. 	<ul style="list-style-type: none"> The requested information will be included if available. Literature and maps from the Corps of Engineers on dredging of the shipping channels was obtained but this information does not apply to the area adjacent to the bulkhead. 	
	<ul style="list-style-type: none"> The references in the text (page 3-1) for the tables and figures are incorrectly referenced in Section 3.2 as Tables 4-1 and 4-1 and Figure 4-1 (there are no such items in the work plan), instead of the correct Tables 3-1 and 3-2 and Figure 3-1. 	<ul style="list-style-type: none"> The corrections will be made to the tables and figure. 	Section 3.2

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General Comments OU2 RI/FS Appendix A – Field Sampling Plan			
	See General Comments 1 through 6 on OU1 FSP. [Comments 1 through 6 are presented below:]		
1	Data Quality Objectives (DQO's) are qualitative and quantitative statements that clarify the study objectives, define most appropriate type of data to collect, determine the most appropriate conditions from which to collect the data; and specify tolerable limits on decision error which will be used as the basis for establishing the quantity and quality of data needed to support the decision. DQO's are presented during the planning phase and refined throughout the implementation and assessment phases.	DQOs have been developed with EPA input over the last several months (May 2006 to July 2006). These DQOs are presented in Section 5.1 of the WP and in the QAPP.	Section 5.1
2	During the planning phase, the intended use of environmental data to be collected is specified and the management and technical activities associated with the generation of the data are presented. DQOs are established during this phase. Planned activities are executed during the implementation phase. At this point the information developed in the DQO process is used in the development of the Quality Assurance Project Plan (QAPP). The implementation phase is followed by an assessment phase, where results of the sampling and analysis activities are evaluated to determine if the assumptions made during planning were satisfied.	See response to Comment 1 above.	Section 5.1 of the WP
3	It is important to apply the DQO process early in the planning stage of the project. The DQO process should be first introduced in the RI/FS work plan and followed on in the QAPP and Field Sampling Plan (FSP).	The DQOs have been presented in the Revised WP and QAPP.	Section 5.1 of the WP
4	DQOs are presented in Appendix B, Quality Assurance Project Plan, making it difficult to follow the planning and implementation of the DQO Process. In addition, they are too general to build a site specific decision-making framework. The seven step process needs to be presented in more detail in the work plan and continued on in the FSP and QAPP. Specifically, the seven steps of the DQO process need to be applied to each investigation area or major investigation activity. For example, DQOs need to be developed for subsurface soil investigation, groundwater	DQOs have been developed for the RI following the seven step process and most recent EPA guidance (EPA 2006). DQOs have been developed for most investigation areas. More specific DQOs will be developed for future activities such as the BERA and BHHRA.	Section 5.1 of the WP

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	investigation, and water level measurements. In addition, Section 1.4.2 indicates that field screening test kits will be used to determine where to collect subsequent samples. The DQOs for the screening samples must be clearly defined, including detection limits for the analyses and decision rules that will be used to select samples for confirmatory and/or full analyses.		
5	Develop a detailed table that defines the seven steps of the DQO process for each decision unit (i.e., investigation areas, screening samples, water level measurements, etc)	The DQOs were developed as a table but then revised based on EPA comments and the most recent EPA guidance. DQOs are now presented in a narrative format in the revised RI/FS Work Plan and revised QAPP.	Section 5.1 of the WP
6	There are inconsistencies between the sampling objectives in Section 5 of the work plan and Table 1-1 of Appendix A, FSP. Inconsistencies also exist in the CLP Method for Organics between the FSP and QAPP. Please clarify.	The FSP has been revised accordingly.	
Specific Comments OU2 RI/FS Appendix A – Field Sampling Plan			
1	Section 3.2.3, Sampling Equipment Decontamination: The decontamination procedure described does not include either an acid nor solvent rinse. Please provide explanation for excluding these steps or revise procedure to include these additional decontamination steps.	The FSP has been revised to include a solvent and acid rinse.	Section 3.2.3
Specific Comments OU2 RI/FS Appendix B – Section 1.4.1, Data Quality Objectives			
1	<p>See comment on OU1 Appendix B, Data Quality Objectives. [Comment presented below:]</p> <p>To assist in the preparation of sampling plan following the DQO Process, refer to the following website: http://dgo.pnl.gov/vsp/</p> <p>The Seven Step process is summarized below:</p> <p>Step 1. Please include the following information:</p> <ul style="list-style-type: none"> Identify members of the DQO planning team and their roles in the process. Conceptual site model - Please include reference to Figure 1- 	DQOs have been developed with EPA following the seven step process and the most recent EPA guidance (EPA 2006) and are presented in Section 5.1 of the work plan and in the QAPP. DQOs are not presented in the FSP as they are already presented in the WP.	

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	<p>1 Conceptual Site Model and Section 4.1, Site Conceptual Model, of the RI/FS Work Plan.</p> <ul style="list-style-type: none"> • Preliminary exposure scenarios consistent with future uses at the site based on the information included in the conceptual site model. • Brief discussion of resources available and any potential constraints. <p>Step 2. The principal decision stated in this step should be elaborated to include alternative actions that could result from possible outcomes of the principal study question that will resolve the problem and recommendations. In addition, decision statements should be made for each area (i.e., former coal tar distillation plant) or activity (i.e., water level measurements). This approach helps to obtain more specific results in the following steps.</p> <p>Step 3. Clearly state the information needed to resolve the decision statement(s). Please include all information needed by the planning team to resolve the decision statement(s), determine the sources for the information identified as needed, identify the information needed to establish the action level (i.e., ARAR, PRG), and confirm that appropriate analytical methods exist to provide the necessary data.</p> <p>Step 4. Please define the spatial and temporal boundaries that the data must represent to support the decision statement(s). Include a detailed description of the characteristics that define the population of interest; a detailed description and illustration of the geographic limits of each environmental medium (e.g., soil, groundwater) within which the field investigation will be carried out; the time period in which samples will be taken and to which decisions will apply; the most appropriate scale of decision making for each medium of concern; and a description of practical constraints that may impede sampling.</p> <p>Step 5. Prepare "if... then..." statements for each decision statement developed in Step 2. The decision rules established in</p>		

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	<p>this step should combine the outputs from earlier steps and should state the regulatory action to be taken depending on whether the statistical parameter is greater or less than the action level. At this point in the process, the planning team confirms whether the action level exceeds measurement detection limits.</p> <p>Step 6. The possibility of decision errors can never be totally eliminated, although, it can be minimized and controlled. The purpose of this step is to specify the tolerable limits on decision errors. The following activities (to be performed in consultation with EPA) will assist in developing this step: determine the possible range of the parameter of interest; define both types of decision errors and their potential consequences and select the baseline condition; specify a range of possible parameter values where the consequences of a false negative decision error are relatively minor (gray region); assign probability values to points above and below the action level that reflect the tolerable probability for the occurrence of decision errors.</p> <p>Step 7. This step provides a general description of each sampling activity and any other field activity necessary to generate the data needed to satisfy the DQOs. Therefore, please provide the data collection design for the field investigation, along with documentation of the key assumptions underlying the design.</p>		
Comments OU1 and OU2 RI/FS Appendix C – Health and Safety Plan			
	The list of chemical compounds is incomplete. Table 2-1 needs to be amended to include the major constituents of coal tar, ethylbenzene, hydrogen sulfide, lead, arsenic, and pesticides.	The HSP has been revised accordingly.	
	In Section 2.2, a discussion of fall and trip hazards must be included, such as the presence of an old wooden pier in poor condition at and near the bulkhead.	The HSP has been revised accordingly.	
	Section 6.2.6, Community Air Monitoring Plan for OU1 shall include real-time air monitoring for arsenic.	The HSP has been revised to include real-time air particulate monitoring data. This data will be used to estimate arsenic concentrations based on a correlation to site soil arsenic concentrations.	